

HAZARDOUS CONTAMINANTS PROGRAM

CHEMICAL IDENTIFICATION

OCTOBER 1982



Ontario

Ministry
of the
Environment

The Honourable
Keith C. Norton, Q.C.,
Minister

Gérard J. M. Raymond
Deputy Minister

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Ontario Ministry of the Environment

October 1982

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SUMMARY

A List of Chemicals for Further Evaluation comprising 209 substances or classes of substances has been developed by the Hazardous Contaminants Office in co-operation with the Branches and Regions of the Ontario Ministry of the Environment.

This list identifies those chemicals which may be of particular concern to environmental and human health protection. These chemicals will be under evaluation beginning in fiscal year 1982-83 in terms of their environmental and human health effects and exposure potential in Ontario.

This report details the chemical assessment process developed by this Ministry and the identification of chemicals which presently require further evaluation.

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OVERVIEW

The Goal of the Ontario Ministry of the Environment is:

TO ACHIEVE AND MAINTAIN A QUALITY OF THE ENVIRONMENT
INCLUDING AIR, WATER AND LAND - THAT WILL PROTECT HUMAN
HEALTH AND THE ECOSYSTEM AND WILL CONTRIBUTE TO THE
WELL-BEING OF THE PEOPLE OF ONTARIO.

To this end the Hazardous Contaminants Office was established in 1980 to co-ordinate hazardous contaminants activities in the Ministry and to develop a strategy for the management and control of hazardous contaminants in Ontario. In August 1982, this office was incorporated into the Hazardous Contaminants and Standards Branch.

HISTORICAL BACKGROUND - HAZARDOUS CONTAMINANTS PROGRAM

In 1976, a Hazardous Contaminants Technical Committee was established under the leadership of the Air Resources Branch. This committee included representatives from regional and branch offices of the Ministry of the Environment, Ministry of Labour, Ministry of Health, Ministry of Industry and Tourism, and the Federal Environmental Protection Service. Activities were carried out through four working groups: Organic Substances, Inorganic Substances, Radionuclides, and an Inventory Group to develop a quantitative data base on chemicals in Ontario. This committee formally ceased to operate in the spring of 1980 when the Hazardous Contaminants Office was established.

A major achievement of this committee was the establishment of a contaminants priority list, which led to the preparation and publication of several comprehensive background documents on selected groups of chemicals. The major accomplishments of this committee were:

1. 1976 - from a list of 3500 candidate chemicals used in Ontario and Ontario Occupational Health Guidelines, a Hazardous Substances List (HASL) consisting of 150 chemicals divided into three categories was prepared.

2. 1977 - using the HASL, the Hazardous Contaminants Technical Committee undertook a hazard rating exercise. Numerical scores based on human health effects, non-human biological effects, discharge to the environment and social and economic impact were established through a ministry survey. This resulted in the "Priority Chemical Substances List" - 1977 consisting of categories A, B and C. It was also the time during which a province-wide collection of emission/discharge data on 14 chemicals was begun and the computerized Hazardous Contaminants Inventory System (HCIS) was set-up to accept such data.
3. 1979 - an updating and revision of the 1977 list was initiated to ensure that the list represented current thinking about potential problems. The Air Resources Branch and Water Resources Branch co-operated to create an integrated multi-media list.

The above mentioned type of multi-media approach led in 1980 to the establishment of the Hazardous Contaminants Office. In August 1982, this office was incorporated into the Hazardous Contaminants and Standards Branch and has the responsibility of developing a strategy for the management and control of hazardous substances. Fundamental to the implementation of this strategy was the development of a chemical assessment process for the identification of chemicals of concern to this Ministry.

This report details that development.

CHEMICAL ASSESSMENT PROCESS

There are over 44,000 chemicals listed in the Chemical Substance Inventory compiled under the U.S. Toxic Substances Control Act (TSCA, 1979) and an increasing number of new chemicals are being introduced into commerce each year. Only a proportion of these chemicals can or need be reviewed in depth, monitored or regulated. The chemical assessment process developed by the Ministry of the Environment is a multi-step screening process that facilitates the selection of those substances that require further review and possible regulatory action due to their environmental and human health effects and exposure potential in Ontario. The entire process is managed by a Chemical Assessment Committee which is a part of the Hazardous Contaminants Program of the Ministry.

The assessment process consists of five phases, the selection of:

- I Chemicals for Consideration
- II Chemicals for Further Evaluation
- III Priority Chemicals
- IV Action Chemicals
- V Regulated Chemicals

A flowchart of the assessment process is provided in Figure 1.

The endpoint of each phase is a list of chemicals which progress from a lower level of concern, PHASE I, to a higher level of concern PHASE V. In addition, the level of review of the chemicals increases from PHASE I to PHASE V.

CHEMICAL ASSESSMENT PROCESS

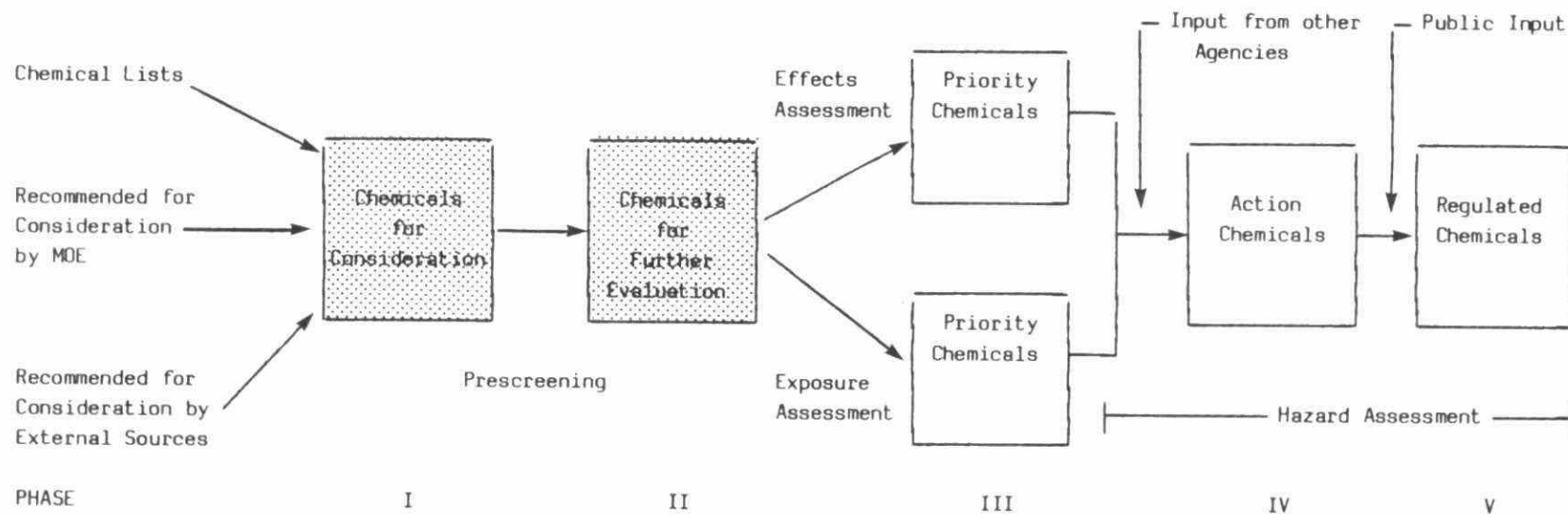


Figure 1

-this report addresses Phases I and II

PHASE I: CHEMICALS FOR CONSIDERATION

The input of chemicals into this phase comes from the chemical lists advocated by recognized agencies or organizations that have regulatory or assessment responsibilities, specific chemicals of concern to this Ministry, and chemicals of concern to other government agencies, industry or the public and have been recommended to this Ministry for consideration.

Chemicals used exclusively as food additives or drugs are screened out in this phase and are thus not included on the list of chemicals for consideration. Chemicals exclusively used as pesticides are flagged in the process and forwarded for further consideration to the Pesticides Control Section of this Ministry.

PHASE II: CHEMICALS FOR FURTHER EVALUATION

This phase consists of identifying those chemicals from the list of Chemicals for Consideration which require further evaluation. The criteria for the "promotion" of a substance to the List of Chemicals for Further Evaluation are:

- A. the substance or class of substances must be on three or more chemical lists as identified by the Chemical Assessment Committee

and/or

- B. the substance or class of substances is:

- (i) a human positive carcinogen
and/or
- (ii) a potential human carcinogen
and/or
- (iii) an animal positive carcinogen
and/or
- (iv) a confirmed hereditary mutagen
and/or
- (v) a confirmed teratogen

as defined and assessed in the Air Priority Chemicals List, Department of Natural Resources, State of Michigan, 1981 (Appendix II).

and/or

- C. the substance or class of substances has been recommended for further evaluation by the Chemical Assessment Committee.

PHASE III: PRIORITY CHEMICALS

This phase evaluates those chemicals from the list of Chemicals for Further Evaluation in terms of their environmental and human health effects and their exposure potential in Ontario. These health effects consist of A: toxicological effects which include but are not limited to carcinogenicity, teratogenicity, mutagenicity, and acute and chronic effects; B: environmental fate factors which include but are not limited to bioaccumulation, persistence, and environmental transport and transformation. Exposure will be evaluated through an industrial inventory and an ambient monitoring inventory. The industrial inventory will address emissions and discharges, use and manufacture, and import and export for chemicals which are under further evaluation.

As a preliminary environmental and human health effects assessment of the chemicals on the List of Chemicals for Further Evaluation, this Ministry has initially used the scoring and assessment procedures developed by the Department of Natural Resources, State of Michigan (Appendix II). It should be stressed that the Michigan assessments have not been thoroughly reviewed by the Ministry and are only intended to be used as preliminary data in the screening of chemicals for environmental and human health effects. Chemicals which warrant further evaluation will be thoroughly reviewed by Ministry staff.

Chemicals which are of concern due to their adverse health effects or exposure potential are designated as Priority Chemicals. A formal chemical hazard assessment methodology to assess Priority Chemicals is a prime consideration of this Ministry and is presently being pursued by the Chemical Assessment Committee, the appropriate branches of the Ministry and agencies involved in health effects assessment.

PHASE IV: ACTION CHEMICALS

Chemicals from the Priority Chemicals List which have been assessed to be hazardous and for which Ministry Programs, Ministry sponsored research or regulatory development have been recommended are designated as Action Chemicals. The regulatory and standard setting process is currently under review by the Ministry and will have provisions for public involvement.

PHASE V: REGULATED CHEMICALS

This phase identifies those chemicals which are regulated by the Ministry. Mitigative action and surveillance follow this phase.

This report details the development and results of PHASE I, Chemicals for Consideration and PHASE II, Chemicals for Further Evaluation. In addition the Preliminary Environmental and Human Health Effects Assessments of the Chemicals for Further Evaluation are addressed in Appendix II.

DEVELOPMENT AND RESULTS OF PHASE I

Chemicals for Consideration

The development of the List of Chemicals for Consideration, the endpoint of this phase, is shown in a flowchart in Figure 2. The two major steps in the development of this list were A: the identification of chemical lists produced by recognized agencies which have regulatory or assessment responsibilities; and B: the selection of substances for consideration that were either not addressed by the chemical lists selected or the rejection of substances, such as pesticides, that were cited on the selected lists but do not fall under the mandate of the Hazardous Contaminants Program.

Selection of Chemicals for Inclusion on the List of Chemicals for Consideration

(I) Selection of Chemical Lists

To limit the number of chemicals to those of highest concern chemicals identified in chemical lists advocated by recognized agencies or organizations were reviewed for consideration. The criteria for the selection of the lists were:

- (1) the list identifies substances that have potential for adverse effects on human health or the environment
and/or

Phase I: Chemicals for Consideration

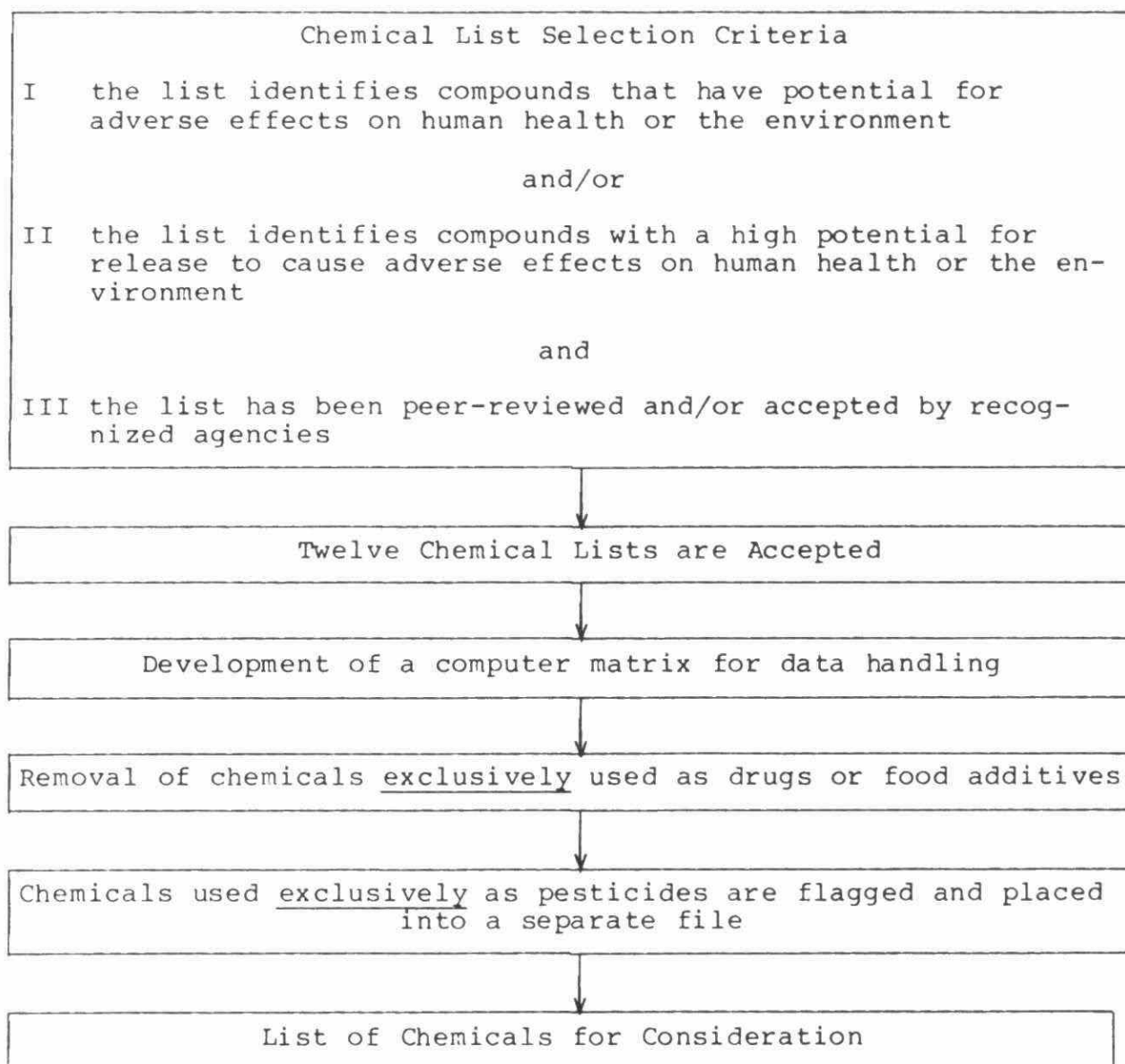


Figure 2

(2) the list identifies substances with a high potential for release to cause adverse effects on human health or the environment

and

(3) the list has been peer-reviewed and/or accepted by recognized agencies or organizations

With the application of the aforementioned criteria and by screening out chemical lists which were considered to be duplicates or redundant due to similar rationale in their development, twelve lists were accepted and are identified in Table 1.

(II) Selection of Chemicals for Consideration

(a) Chemicals identified on the Chemical Lists

The substance or class of substances identified from the chemical lists chosen was entered on computer in a matrix format. A value of "1" was entered if the substance or class of substances was listed on a chemical list or a value of "0" was entered if it was absent from a chemical list. In addition, where available, a CAS number* was listed for each substance to facilitate the purging of duplicates. The substances were then relisted according to the number of chemical lists on which the substances occurred. These range from a maximum of twelve lists to a minimum of one list.

* the CAS number is the Chemical Abstract Service number which is a unique number assigned to a chemical for reference purposes

A section of the computer printout has been reproduced in Figure 3 displaying the chemical name, CAS number, chemical lists chosen and the total number of lists on which the chemical appeared.

Chemicals used exclusively as drugs or food additives were removed from the list since they do not fall under the mandate of the Hazardous Contaminant Program and are the responsibility of other government agencies. Chemicals used exclusively as pesticides were flagged and listed in a separate file for forwarding to the Pesticides Control Section of this Ministry since those substances are regulated and controlled under the Pesticides Control Act.

In total, more than 1200 substances or classes of substances are listed on the List of Chemicals for Consideration

- (b) Recommendations for the Inclusion of Substances on the List of Chemicals for Consideration

Substances are added to the List of Chemicals for Consideration by three mechanisms:

- (1) the substances or classes of substances are on a chemical list selected by the Chemical Assessment Committee

This mechanism has been dealt with.

- (2) the chemical is of concern to a Branch, Region or the Hazardous Contaminants Office of the Ministry and is recommended for consideration.

Requests for additions to the List of Chemicals for Consideration can be made by any branch or region of the Ministry or by the Hazardous Contaminants Office. The submission should detail the following information:

- .1 date of submission
- .2 source of submission
- .3 name of substance(s), CAS number if available
- .4 reasons for consideration, including background reference material if available
- .5 present Ministry activity with respect to the substance if applicable

- (3) the chemical is of concern to other government agencies, industry or the public and has been recommended to this Ministry for consideration.

Requests from other government agencies, industry or the public should follow the same procedure as outlined for Ministry requests with the exclusion of information item (.5).

Submissions should be sent to the attention of the Co-ordinator, Hazardous Contaminants Office, 135 St. Clair Ave. W., 7th Floor, Toronto, Ontario, M4V 1P5.

Screening:

Submissions will only be screened for chemical nomenclature accuracy before requests are processed for possible inclusion on the List of Chemicals for Consideration. If the nomenclature is incorrect the submitter will be notified. If the nomenclature is correct there are two possibilities:

- (1) The chemical is already on the List of Chemicals for Consideration.

The information submitted will be checked against the information on file. If the submitted information represents new data, then the chemical will be flagged for future review. If the submitted data is already on file then the status of the chemical will not change. In either case the submitter will be notified.

- (2) The chemical is not on the List of Chemicals for Consideration.

The chemical will be added to the list and a chemical information file will be opened. The chemical will be flagged for review. The submitter will be notified of this decision.

Update:

Submissions for the addition of compounds to the list will be processed as the need arises. An updated List of Chemicals for Consideration indicating the status of all chemicals will be available annually.

TABLE 1

CHEMICAL LISTS SELECTED FOR THE DEVELOPMENT OF THE LIST OF
CHEMICALS FOR CONSIDERATION (1)

- . Revised Priority Chemicals List, June 1979,
Hazardous Contaminants Technical Committee, Ontario Ministry
of the Environment (RPCL/MOE) (2)
- . Ontario Inventory for Specified Chlorinated and Aromatic
Hydrocarbons, 1978: Ontario Ministry of the Environment
(OI/MOE)
- . Water Management - Goals, Policies, Objectives and
Implementation Procedures of the Ontario Ministry of the
Environment, 1978 (WMO/MOE)
- . List of Standards, Tentative Standards, Guidelines and
Provisional Guidelines for Air Contaminants, Ontario Ministry
of the Environment, 1982 (AC/MOE)
- . Substances Found in the Great Lakes Basin, Great Lakes Water
Quality Board, 1978, International Joint Commission (GLB/IJC)
- . Priority and Candidate Chemicals, 1980, Environmental
Contaminants Act, Environment Canada and Health and Welfare
Canada (PCC/ECA)
- . Critical Materials Register and Air Priority Chemicals List,
Michigan Department of Natural Resources, 1981, Michigan,
U.S.A. (MDNR)

TABLE 1 (continued)

- . Priority Pollutants List, 1978, U.S. Environmental Protection Agency (PPL/EPA)
- . Chemicals Recommended to the U.S. Environmental Protection Agency for Further Testing by the U.S. Interagency Testing Committee, 1981 (EPA/ITC)
- . Chemicals for Review by the U.S. Interagency Testing Committee, 1980 (CR/ITC)
- . Hazardous Substances, U.S. Interagency Regulatory Liaison Group, 1979 (IRLG)
- . List of Substances which may be Candidates for Further Scientific Review and Possible Identification, Classification, and Regulation as Potential Occupational Carcinogens, U.S. Occupational Safety and Health Administration, 1980 (POC-OSHA)

-
- (¹) A detailed description of each chemical list is provided in Appendix 1.
 - (²) The acronym assigned to each chemical list was used for the computer matrix printout, Figure 3, and is not necessarily a recognized acronym.

DEVELOPMENT AND RESULTS OF PHASE II

Chemicals for Further Evaluation

The development of the List of Chemicals for Further Evaluation, the endpoint of this phase, is shown by a flowchart in Figure 4.

Selection Criteria

The selection criteria for the "promotion" of chemicals from the List of Chemicals for Consideration to the List of Chemicals for Further Evaluation are:

- (A) the substance or class of substances is on three or more chemical lists as selected by the Chemical Assessment Committee

and/or

- (B) the substance or class of substances is:

- (i) a Human Positive Carcinogen*

and/or

- (ii) a Potential Human Carcinogen*

and/or

- (iii) an Animal Positive Carcinogen*

and/or

- (iv) a Confirmed Hereditary Mutagen*

and/or

- (v) a Confirmed Teratogen*

* Air Priority Chemicals List, Department of Natural Resources, State of Michigan (1981) (Appendix II)

Phase II: Chemicals for Further Evaluation

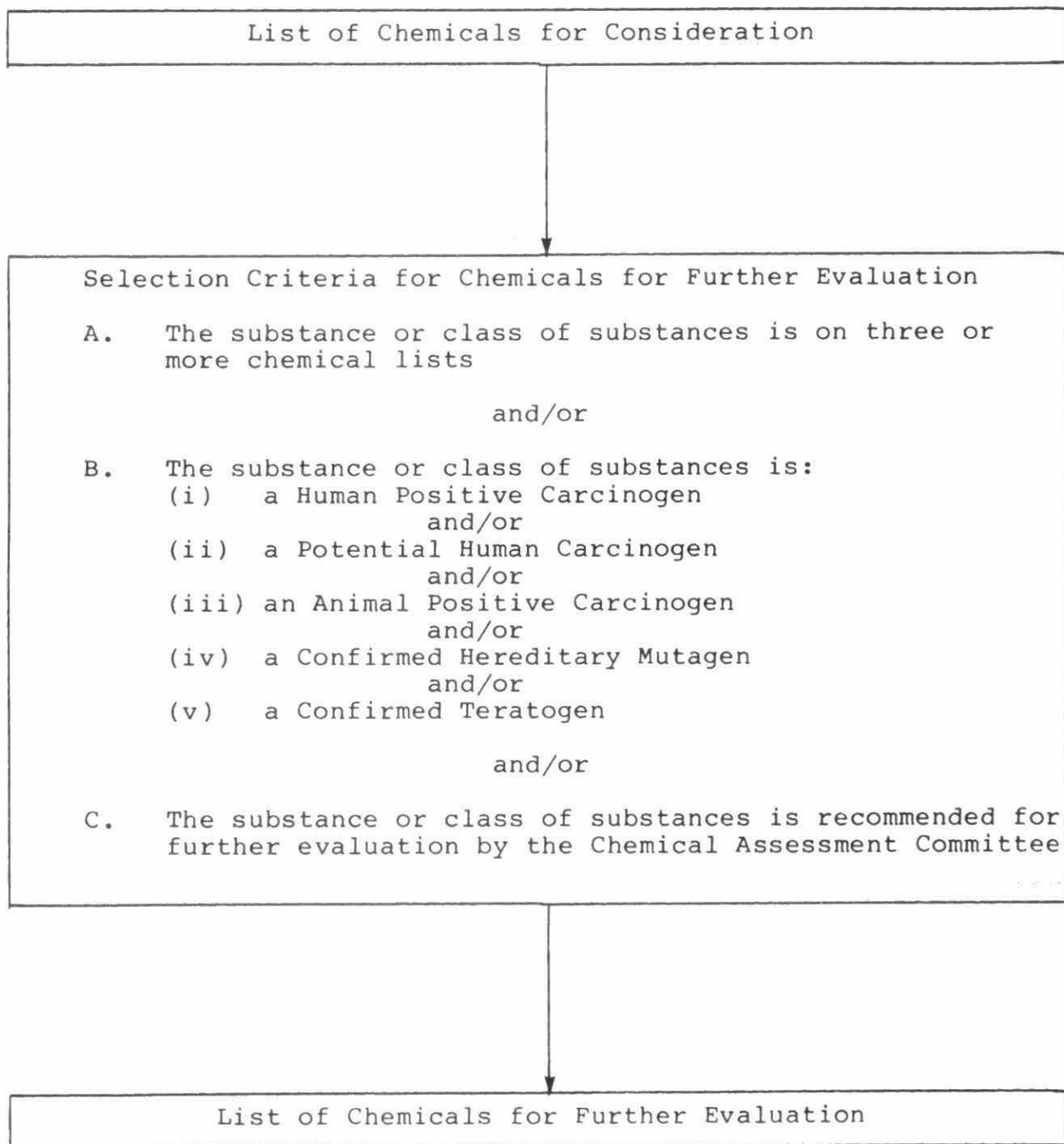


Figure 4

and/or

- (C) The substance or class of substances is recommended for further assessment by the Chemical Assessment Committee

Further Explanation of Criterion C

The Chemical Assessment Committee developed criteria A and B to identify those substances or classes of substances of greatest concern on the List of Chemicals for Consideration. The Chemical Assessment Committee realized that Criterion A - that a substance or class of substances would need to be listed on three or more chemical lists for "promotion" to the List of Chemicals for Further Evaluation - was not sufficient in identifying all chemicals of environmental concern in Ontario. In addition, the committee realized that substances of no known significance in Ontario or "conventional contaminants", such as nitrogen oxides and sulphates, which are regulated and are under surveillance programs by the Ministry may be "promoted" to the List of Chemicals for Further Evaluation through the application of this criterion. These concerns led to development of criterion C - in which the entire list of chemicals for consideration is reviewed by the Chemical Assessment Committee. Each member of the Committee was given a listing of the Chemicals for Consideration and asked in consultation with other Ministry staff to use their professional judgement and expertise in their media of concern to demote or promote a substance on the list. The members of the committee collectively discussed the results of the individual assessments and arrived at a consensus on which substances or classes of substances should be promoted or demoted.

This process led to the development of a DELPHI SCORE (see Figure 3) in which a chemical which was on less than three lists and had a total score of less than three, was given a score of three if the chemical was assessed as being of concern by the committee. Substances or classes of substances known to be of no concern in Ontario were demoted to a total of two.

In total, 209 substances or classes of substances are listed on the List of Chemicals for Further Evaluation. The list was reviewed by the Ministry and 23 chemically significant groups were identified. An alphabetical list of entries is presented in Table 2. This table includes the CAS number, group classification and listing criteria for each entry. The group names and corresponding group numbers are listed in Table 3, and the list arranged by group classification appears in Table 4.

Summary statistics providing the number of entries, number of classes, number of substances and number of preliminary environmental and human health assessments for the entries under each group classification are presented in Table 5.

TABLE 2
CHEMICALS FOR FURTHER EVALUATION
(ALPHABETICAL LISTING)

	<u>GROUP CLASSIFICATION</u>	<u>CAS + NUMBER</u>	<u>LISTING *</u> <u>CRITERIA</u>
acenaphthene, 5-nitro	XVIII	00602879	B(iii)
acenaphthylene	III	00208968	C
acetonitrile	XVIII	00075058	C
2-acetylaminofluorene	XVIII	00053963	B(i)
acrylonitrile	XVIII	00107131	A,B(iii)
alkyl amines	XVIII	G	C
alkyl epoxides	XII	G	C
allyl chloride	XI	00107051	C
aluminum & selected compounds	XXIII	07429905G	C
2-aminoanthraquinone	X	00117793	B(iii)
aminoazobenzene	X	00060093	B(iii)
o-aminoazotoluene	X	00097563	B(iii)
4-aminobiphenyl	X	00092671	B(i)
3-amino-9-ethylcarbazole	X	00132321	B(iii)
1-amino-2-methyl anthraquinone	X	00082280	B(iii)
aminotriazole	X	00061825	B(iii)
aniline	X	00062533	A
o-anisidine	X	00090040	B(iii)

* description of Listing Criteria provided on page 33

+the Chemical Abstract Service (CAS) number is listed if available.
Classes of substances are denoted by a G or by the CAS number followed by a G if the main substance in the class has a unique CAS number e.g. aluminum and selected compounds; 07429905G, where 07429905 is the CAS number for aluminum.

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
o-anisidine hydrochloride	X	00134292	B(iii)
antimony & selected compounds	XXIII	07440360G	A
aromatic amines	X	G	C
arsenic & selected compounds	XXIII	07440382G	A,B(i)
aryl sulfonic acids	XX	G	C
anthracene	III	00120127	A
asbestos and related asbestos fibres	XXIII	01332214G	B(iii)
azo dyes	XVIII	G	C
benz(a)acridine	XVIII	00225116	C
benz(c)acridine	XVIII	00225514	C
benz(a)anthracene	III	00056553	A,B(iii)
benz(a)anthracene, 7-12-dimethyl	III	00057976	C
benzene	I	00071432	A,B(ii)
benzidine and salts	X	00092875G	A,B(i)
benzo(b)fluoranthene	XVIII	00205992	C
benzo(j)fluoranthene	III	00205823	C
benzo(k)fluoranthene	III	00207089	C
benzo(ghi)perylene	III	00151242	C
benzo(a)pyrene	III	00050328	A,B(iii)
benzo(e)pyrene	III	00192972	C
benzothiazole	XX	00095169	C
benzyl chloride	XI	00100447	C

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
benzylbutyl phthalate	IX	00085687	A
beryllium & selected compounds	XXIII	07440417G	A,B(iii)
biphenyl	II	00092524	A
bromodichloromethane	XI	00075274	A
bromoform	XI	00075252	A
cadmium & selected compounds	XXIII	07440439G	A,B(i)
carbon disulphide	XX	00075150	C
carbon tetrachloride	XI	00056235	A,B(ii)
chlorinated cresols	VI	G	C
chlorinated naphthalenes	V	G	A
chlorinated paraffins	XI	G	C
chlorinated phenols	VI	G	C
chlorinated styrenes	IV	G	C
chloro-anilines	XVIII	G	C
chlorobenzenes	IV	G	A
chlorodibromomethane	XI	00124481	C
1-chloro-2,3-epoxypropane	XII	00106898	C
2-chloroethanol	XIV	00107073	C
bis(2-chloroethyl)ether	XIV	00111444	A
chlorofluorocarbons	XI	G	C
chloroform	XI	00067663	A,B(iii)
bis(2-chloro-isopropyl)ether	XIV	00108601	B(i)

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
bis(chloromethyl)ether	XIV	00542881	A,B(i)
3-(chloromethyl)pyridine hydrochloride	IV	06959484	B(iii)
4-chloro-m-phenylenediamine	X	05131602	B(iii)
4-chloro-o-phenylenediamine	X	00095830	B(iii)
chloroprene	XI	00126998	B(v)
chromium & selected compounds	XXIII	07440473G	A,B(i)
chrysene	III	00218019	C
cobalt & selected compounds	XXIII	07440484G	A
copper & selected compounds	XXIII	07440508G	A
p-cresidine	X	00120718	B(iii)
cresols	VII	G	A
cyanides	XXIII	G	A
cyclohexane	XX	00110827	C
cyclohexanone	XX	00108941	C
cycloheximide	XVIII	00066819	C
dehydroabietic acid	XIII	01740198	C
2,4-diaminoanisole sulfate	X	39156417	B(iii)
4,4'-diaminodiphenyl ether	X	00101804	B(iii)
2,4-diaminotoluene	X	00095807	B(iii)
dibenz(a,h)anthracene	III	00053703	A,B(iii)
dibenzo(b,def)chrysene	III	00189640	A
dibenzo(a,i)pyrene	III	00189559	C

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
dibenzo(def,mno)pyrene	III	00191264	C
tris(dibromopropyl)phosphate	XXII	00126727	B(iii)
di-n-butyl phthalate	IX	00084742	A
1,3-dichlorobenzene	IV	00541731	A
3,3'-dichlorobenzidine & salts	XVIII	00091941G	A,B(ii)
1,1-dichloroethane	XI	00075343	A
1,2-dichloroethane	XI	00107062	A,B(iii)
1,2-dichloroethylene	XI	00540590	A
1,2-dichloropropane	XI	00078875	A
1,2:3,4-diepoxybutane	XII	00298180	B(iii)
diethyl phthalate	IX	00084662	C
di-isobutyl phthalate	IX	00084695	C
4-dimethylaminoazobenzene	X	00060117	B(ii)
dimethylhydrazines	XVIII	G	B(iii)
dimethyl phthalate	IX	00131113	C
dimethyl sulphate	XX	00077781	C
di-n-octyl phthalate	IX	00117840	A
1,4-dioxane	XX	00123911	A,B(iii)
diphenylamine	X	00122394	C
ethyl benzene	I	00100414	A
ethylene dibromide	XI	00106934	A,B(iii)
ethyleneimine	XVIII	00151564	B(ii)

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
ethylene oxide	XII	00075218	A,B(iv)
ethylene thiourea	XX	00096457	B(iii,v)
bis(2-ethylhexyl)phthalate	IX	00117817	A
ethyl methanesulfonate	XX	00062500	B(iv)
fatty acids	XX	G	C
fluorides	XXIII	G	C
fluoroalkenes	XI	G	C
formaldehyde	XXI	00050000	A
2-(2-formylhydrazino)-4-(5-nitro -2-furyl) thiazole	XX	03570750	B(iii)
furfural	XXI	00098011	A
glycidol & its derivatives	XII	00556525G	C
hexachlorobenzene	IV	00118741	A,B (iii,v)
hexachlorobutadiene	XI	00087683	A
hexachlorocyclohexane	XI	00608731	B(iii)
hexachlorocyclopentadiene	XV	00077474	A
hexachloroethane	XI	00067721	A
hexamethylphosphoramide	XVIII	00680319	B(iii)
hydrazine	XVIII	00302012	A,B(iii)
hydrazobenzene	X	00122667	B(iii)
indeno(1,2,3 -cd)pyrene	III	00193395	A
lead & selected compounds	XXIII	07439921G	A,B(iii)

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
mercaptans	XX	G	C
mercury & selected compounds	XXIII	07439976G	A,B(v)
methyl chloride	XI	00074873	A
methyl(chloromethyl)ether	XIV	00107302	B(ii)
methylenebis(2-chloroaniline)	XVIII	00101144	B(ii)
4,4'-methylenebis (N,N-dimethylaniline)	X	00101611	B(iii)
4,4'-methylenebis(2-methylaniline)	X	00838880	B(iii)
methylene chloride	XI	00075092	A
1,2-(methylenedioxy) -4-propenyl-benzene	XX	00120581	B(iii)
methyl hydrazine	XVIII	00060344	C
methyl mercaptan	XX	00074931	C
2-methyl-1-nitroanthraquinone	XVIII	00129157	B(iii)
mirex	XV	02385855	A,B(iii)
naphthalene	II	00091203	A
1,5-naphthalenediamine	X	02243621	B(iii)
1-naphthylamine	X	00134327	A,B(ii)
2-naphthylamine	X	00091598	A,B(i)
nickel & selected compounds	XXIII	07440020G	A,B(ii)
nitro-anilines	XVIII	G	C
5-nitro-o-anisidine	X	00099592	B(iii)
nitro-aromatics	XVIII	G	C
4-nitrobiphenyl	XVIII	00092933	B(ii)

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
nitrosamines	XIX	G	A
N-nitroso-n-butyl-N- (4-hydroxybutyl)amine	XIX	03817116	B(i)
N-nitroso-di-n-butylamine	XIX	00924163	B(iii)
N-nitrosodiethylamine	XIX	00055185	B(iii)
N-nitrosodimethylamine	XIX	00062759	A,B(ii)
p-nitrosodiphenylamine	X	00156105	B,A(iii)
N-nitroso-N-ethylurea	XIX	00759739	B(ii)
N-nitroso-N-methylurea	XIX	00684935	B(iii)
N-nitroso-N-methylurethane	XIX	00615532	B (iii,iv)
N-nitrosomethylvinylamine	XIX	04549400	B(iii)
N-nitrosomorpholine	XIX	00059892	B(iii)
N-nitroso-N-phenylhydroxylamine -ammonium salt	XIX	00135206	B(iii)
N-nitrososarcosine	XIX	13256229	B(iii)
pentachlorophenol	VI	00087865	A
phenanthrene	III	00085018	C
phenols	VII	00108952G	A
phenylenediamines	X	G	C
phosgene	XX	00075445	C
phthalate esters	IX	G	A
polyaromatic hydrocarbons (PAH's)	III	G	A
polybrominated biphenyls (PBB's)	V	G	A

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
polychlorinated biphenyls (PCB's)	V	G	A,B(iii)
polychlorinated dibenzodioxins (PCDD's)	XVI	G	B(v)
polychlorinated dibenzofurans (PCDF's)	XVII	G	C
polychlorinated terphenyls	XV	G	A
propane, 2-nitro	XVIII	00079469	C
1,3-propane sultone	XX	01120714	B(iii)
beta-propiolactone	XX	00057578	B(ii)
5-propyl-1,3-benzodioxole	XX	00094586	B(iii)
propyleneimine	XVIII	00075558	B(iii)
pyrene	III	00129000	C
quinoline	XVIII	00091225	A
resin acids	XIII	G	C
selenium & selected compounds	XXIII	07782492G	A,B(iii, v)
semicarbazide	XVIII	00057567	B(v)
silver & selected compounds	XXIII	07440224G	A
strontium & selected compounds	XXIII	07440246G	A
styrene	I	00100425	A
2,3,7,8-tetrachlorodibenzo-p-dioxin	XVI	01746016	A
1,1,2,2-tetrachloroethane	XI	00079345	C
tetrachloroethylene	XI	00127184	A,B(iii)
tetranitromethane	XVIII	00509148	C
thallium & selected compounds	XXIII	07440280G	A
4,4'-thiodianiline	X	00139651	B(iii)

TABLE 2 (continued)

	<u>GROUP CLASSIFICATION</u>	<u>CAS NUMBER</u>	<u>LISTING CRITERIA</u>
thiourea	XX	00062566	B(iii)
toluene	I	00108883	A
o-toluidine	X	00095534	A
o-toluidine hydrochloride	X	00636215	B(iii)
triaryl phosphate esters	XXII	G	C
1,2,4-trichlorobenzene	IV	00120821	A
1,1,1-trichloroethane	XI	00071556	A
1,1,2-trichloroethane	XI	00079005	A
trichloroethylene	XI	00079016	A
trichlorophenols	VI	G	A,B(iii)
2,4,5-trimethylaniline	X	00137177	B(iii)
vanadium & selected compounds	XXIII	07440622G	A
vinyl chloride	XI	00075014	A,B(ii)
vinylidene chloride	XI	00075354	B(iii)
xylene	I	01330207	A
zinc & selected compounds	XXIII	07440666G	A

TABLE 2 (continued)

Listing Criteria

- A - the substance or class of substances is on three or more chemical lists.
- B - the substance or class of substances is a:
 - (i) human positive carcinogen
 - (ii) potential human carcinogen
 - (iii) animal positive carcinogen
 - (iv) confirmed hereditary mutagen
 - (v) confirmed teratogen
- C - the substance or class of substances is recommended for further evaluation by the Chemical Assessment Committee.

TABLE 3

GROUP CLASSIFICATION

I	MONO AROMATIC HYDROCARBONS
II	DIAROMATIC HYDROCARBONS
III	POLYAROMATIC HYDROCARBONS (PAH's)
IV	HALOGENATED MONOAROMATICS
V	HALOGENATED DIAROMATIC HYDROCARBONS
VI	HALOGENATED PHENOLS
VII	HYDROXYLATED MONOAROMATIC HYDROCARBONS (PHENOLS)
VIII	HYDROXYLATED DIAROMATICS
IX	PHTHALATE ESTERS
X	AROMATIC AMINES
XI	HALOGENATED ALKANES AND ALKENES
XII	ALKYL EPOXIDES
XIII	RESIN ACIDS AND DERIVATIVES
XIV	CHLOROALCOHOLS AND ETHERS
XV	POLYCHLORINATED COMPOUNDS N.O.S.
XVI	CHLORINATED DIBENZODIOXINS
XVII	CHLORINATED DIBENZOFURANS
XVIII	NITROGEN COMPOUNDS N.O.S.
XIX	NITROSAMINES
XX	COMPOUNDS NOT OTHERWISE SPECIFIED
XXI	ALDEHYDES
XXII	PHOSPHATE ESTERS
XXIII	INORGANICS, METALS, FIBRES

N.O.S. - not otherwise specified

Table 4

CHEMICALS FOR FURTHER EVALUATION - GROUP LISTING

I.	<u>MONO AROMATIC HYDROCARBONS</u>	CAS
	benzene	00071432
	ethyl benzene	00100414
	styrene	00100425
	toluene	00108883
	xylene	01330207
II.	<u>DI-AROMATIC HYDROCARBONS</u>	
	biphenyl	00092524
	naphthalene	00091203
III.	<u>POLYAROMATIC HYDROCARBONS (PAH's)</u>	
	polyaromatic hydrocarbons	G
	acenaphthylene	00208968
	anthracene	00120127
	benz(a)anthracene	00056553
	benz(a)anthracene, 7-12- dimethyl	00057976
	benzo(b)fluoranthene	00205992
	benzo(j)fluoranthene	00205823
	benzo(k)fluoranthene	00207089
	benzo(ghi)perylene	00151242
	benzo(a)pyrene	00050328
	benzo(e)pyrene	00192972
	chrysene	00218019
	dibenz(a,h)anthracene	00053703

TABLE 4 (continued)

	dibenzo(b,def)chrysene	00189640
	dibenzo(def,mno)pyrene	00191264
	dibenzo(a,i)pyrene	00189559
	indeno(1,2,3-cd)pyrene	00193395
	phenanthrene	00085018
	pyrene	00129000
IV.	<u>HALOGENATED MONOAROMATICS</u>	
	chlorinated styrenes	G
	chlorobenzenes	G
	1,3-dichlorobenzene	00541731
	hexachlorobenzene	00118741
	1,2,4-trichlorobenzene	00120821
	3-(chloromethyl)pyridine hydrochloride	06959484
V.	<u>HALOGENATED DIAROMATIC HYDROCARBONS</u>	
	chlorinated naphthalenes	G
	polybrominated biphenyls (PBB's)	G
	polychlorinated biphenyls (PCB's)	G
VI.	<u>HALOGENATED PHENOLS</u>	
	chlorinated cresols	G
	chlorinated phenols	G
	pentachlorophenol	00087865
	trichlorophenols	G
VII.	<u>HYDROXYLATED MONOAROMATIC HYDROCARBONS (PHENOLS)</u>	
	cresols	G
	phenols	00108952G

TABLE 4 (continued)

VIII. HYDROXYLATED DIAROMATICSIX. PHTHALATE ESTERS

phthalate esters	G
benzylbutyl phthalate	00085687
di-n-butyl phthalate	00084742
diethyl phthalate	00084662
di-isobutyl phthalate	00084695
dimethyl phthalate	00131113
di-n-octyl phthalate	00117840
bis(2-ethylhexyl)phthalate (DEHP)	00117817

X. AROMATIC AMINES

aromatic amines	G
2-aminoanthraquinone	00117793
aminoazobenzene	00060093
o-aminoazotoluene	00097563
4-aminobiphenyl	00092671
3-amino-9-ethylcarbazole	00132321
1-amino-2-methyl -anthraquinone	00082280
aminotriazole	00061825
aniline	00062533
o-anisidine	00090040
o-anisidine hydrochloride	00134292
5-nitro-o-anisidine	00099592
o-toluidine	00095534
o-toluidine hydrochloride	00636215
2,4,5-trimethylaniline	00137177

TABLE 4 (continued)

X.	<u>AROMATIC AMINES</u>	
	benzidine and salts	00092875G
	p-cresidine	00120718
	2,4-diaminoanisole sulfate	39156417
	4,4'-diaminodiphenyl ether	00101804
	2,4-diaminotoluene	00095807
	4-dimethylaminoazobenzene	00060117
	diphenylamine	00122394
	hydrazobenzene	00122667
	4,4'-methylenebis(2-methylaniline)	00838880
	4,4'-methylenebis(N,N-dimethylaniline)	00101611
	1,5-naphthalenediamine	02243621
	1-naphthylamine	00134327
	2-naphthylamine	00091598
	p-nitrosodiphenylamine	00156105
	phenylenediamines	G
	4-chloro-m-phenylenediamine	05131602
	4-chloro-o-phenylenediamine	00095830
	4,4'-thiodianiline	00139651
XI.	<u>HALOGENATED ALKANES AND ALKENES</u>	
	allyl chloride	00107051
	benzyl chloride	00100447
	bromodichloromethane	00075274
	bromoform	00075252
	carbon tetrachloride	00056235
	chlorodibromomethane	00124481

TABLE 4 (continued)

chlorofluorocarbons	G
chlorinated paraffins	G
chloroform	0067663
chloroprene	00126998
1,1-dichloroethane	00075343
1,2-dichloroethane	00107062
1,2-dichloroethylene	00540590
1,2-dichloropropane	00078875
ethylene dibromide	00106934
fluoroalkenes	G
hexachlorobutadiene	00087683
hexachlorocyclohexane	00608731
hexachloroethane	00067721
methyl chloride	00074873
methylene chloride	00075092
1,1,2,2-tetrachloroethane	00079345
tetrachloroethylene	00127184
1,1,1-trichloroethane	00071556
1,1,2-trichloroethane	00079005
trichloroethylene	00079016
vinyl chloride	00075014
vinylidene chloride	00075354
XII. <u>ALKYL EPOXIDES</u>	
alkyl epoxides	G
1-chloro-2,3-epoxypropane	00106898
1,2:3,4-diepoxbutane	00298180
ethylene oxide	00075218

TABLE 4 (continued)

	glycidol and its derivatives	00556525G
XIII.	<u>RESIN ACIDS AND DERIVATIVES</u>	
	resin acids	G
	dehydroabietic acid	01740198
XIV.	<u>CHLOROALCOHOLS AND ETHERS</u>	
	2-chloroethanol	00107073
	bis(2-chloroethyl)ether	00111444
	bis(chloromethyl)ether	00542881
	bis(2-chloro-isopropyl)ether	00108601
	methyl(chloromethyl)ether	00107302
XV.	<u>POLYCHLORINATED COMPOUNDS</u> <u>N.O.S.</u>	
	hexachlorocyclopentadiene	00077474
	mirex	02385855
	polychlorinated terphenyls	G
XVI.	<u>CHLORINATED DIBENZODIOXINS</u>	
	polychlorinated dibenzodioxins (PCDD's)	G
	2,3,7,8-tetrachlorodibenzo-p-dioxin	01746016
XVII.	<u>CHLORINATED DIBENZOFURANS</u>	
	polychlorinated dibenzofurans (PCDF's)	G
XVIII.	<u>NITROGEN COMPOUNDS</u> <u>N.O.S.</u>	
	acenaphthene,5-nitro	00602879
	acetonitrile	00075058
	2-acetylaminofluorene	00053963
	acrylonitrile	00107131
	alkyl amines	G
	azo dyes	G

TABLE 4 (continued)

benz(a)acridine	00225116
benz(c)acridine	00225514
chloro-anilines	G
cycloheximide	00066819
3,3'-dichlorobenzidine and salts	00091941G
dimethylhydrazines	G
ethyleneimine	00151564
hexamethylphosphoramide	00680319
hydrazine	00302012
methylenebis(2-chloroaniline)	00101144
methyl hydrazine	00060344
nitro-aromatics	G
nitro-anilines	G
4-nitrobiphenyl	00092933
2-methyl-1-nitroanthraquinone	00129157
propane, 2-nitro	00079469
propyleneimine	00075558
quinoline	00091225
semicarbazide	00057567
tetranitromethane	00509148
XIX. <u>NITROSAMINES</u>	CAS
nitrosamines	G
N-nitroso-n-butyl-N-(4-hydroxybutyl)-amine	03817116
N-nitroso-di-n-butylamine	00924163
N-nitrosodiethylamine	00055185
N-nitrosodimethylamine	00062759
N-nitroso-N-ethylurea	00759739

TABLE 4 (continued)

N-nitroso-N-methylurea	00684935
N-nitroso-N-methylurethane	00615532
N-nitrosomethylvinylamine	04549400
N-nitrosomorpholine	00059892
N-nitroso-N-phenyl- hydroxylamine ammonium salt	00135206
N-nitrososarcosine	13256229
XX. <u>COMPOUNDS NOT OTHERWISE SPECIFIED</u>	
aryl sulfonic acids	G
benzothiazole	00095169
carbon disulphide	00075150
cyclohexane	00110827
cyclohexanone	00108941
dimethyl sulphate	00077781
1,4-dioxane	00123911
ethylene thiourea	00096457
ethyl methanesulfonate	00062500
fatty acids	G
2-(2-formylhydrazino)-4-(5- nitro-2-furyl)thiazole	03570750
mercaptans	G
methyl mercaptan	00074931
1,2-(methylenedioxy)-4-propenyl -benzene	00120581
phosgene	00075445
1,3-propane sultone	01120714
beta-propiolactone	00057578
5-propyl-1,3-benzodioxole	00094586
thiourea	00062566

TABLE 4 (continued)

XXI.	<u>ALDEHYDES</u>	
	formaldehyde	00050000
	furfural	00098011
XXII.	<u>PHOSPHATE ESTERS</u>	
	tris(dibromopropyl)phosphate	00126727
	triaryl phosphate esters	G
XXIII.	<u>INORGANICS, METALS, FIBRES</u>	
	aluminum & selected compounds	07429905G
	antimony & selected compounds	07440360G
	arsenic & selected compounds	07440382G
	asbestos & related asbestos fibres	01332214G
	beryllium & selected cmpds	07440417G
	cadmium & selected compounds	07440439G
	chromium & selected compounds	07440473G
	cobalt & selected compounds	07440484G
	copper & selected compounds	07440508G
	cyanides	G
	fluorides	G
	lead & selected compounds	07439921G
	mercury & selected compounds	07439976G
	nickel & selected compounds	07440020G
	selenium & selected compounds	07782492G
	silver & selected compounds	07440224G
	strontium & selected compounds	07440246G
	thallium & selected compounds	07440280G
	vanadium & selected cmpds	07440622G
	zinc & selected compounds	07440666G

Summary Statistics for the List of Chemicals for Further Evaluation

<u>GROUP CLASSIFICATION</u>		<u># Entries</u>	<u># Classes</u>	<u># Substances</u>	<u>Preliminary Environmental and Human Health Effects Assessments*</u>
I	MONO AROMATIC HYDROCARBONS	5	0	5	3
II	DIAROMATIC HYDROCARBONS	2	0	2	2
III	POLY AROMATIC HYDROCARBONS (PAH's)	19	1	18	7
IV	HALOGENATED MONOAROMATICS	6	2	4	2
V	HALOGENATED DIAROMATIC HYDROCARBONS	3	3	0	2
VI	HALOGENATED PHENOLS	4	3	1	2
VII	HYDROXYLATED MONOAROMATIC HYDROCARBONS (PHENOLS)	2	2	0	2
VIII	HYDROXYLATED DIAROMATICS	0	0	0	0
IX	PHTHALATE ESTERS	8	1	7	3
X	AROMATIC AMINES	33	3	30	31
XI	HALOGENATED ALKANES AND ALKENES	28	3	25	17
XII	ALKYL EPOXIDES	5	2	3	3
XIII	RESIN ACIDS AND DERIVATIVES	2	1	1	0
XIV	CHLOROALCOHOLS AND ETHERS	5	0	5	4
XV	POLYCHLORINATED COMPOUNDS N.O.S.	3	1	2	2
XVI	CHLORINATED DIBENZODIOXINS	2	1	1	1
XVII	CHLORINATED DIBENZOFURANS	1	1	0	1
XVIII	NITROGEN COMPOUNDS N.O.S.	26	6	20	16
XIX	NITROSAMINES	12	1	11	11
XX	COMPOUNDS NOT OTHERWISE SPECIFIED	19	3	16	13
XXI	ALDEHYDES	2	0	2	2
XXII	PHOSPHATE ESTERS	2	1	1	1
XXIII	INORGANICS, METALS, FIBRES	<u>20</u>	<u>20</u>	<u>0</u>	<u>15</u>
TOTAL		209	55	154	140

(# Entries = # Classes + # Substances)

* Assessments are documented in Appendix II

N.O.S. - not otherwise specified

TABLE 5

CHEMICALS FOR CONSIDERATION FOR WHICH STANDARDS, GUIDELINES OR
OBJECTIVES HAVE BEEN SET BY THE ONTARIO MINISTRY OF THE
ENVIRONMENT

Table 6 lists those substances on the List of Chemicals for Consideration which have standards, guidelines or objectives set or adopted by the Ontario Ministry of the Environment and are classified in eight groups:

- . ambient air quality standards (Ref 1, 6)
- . ambient air tentative standards (Ref 5)
- . guidelines for source emissions (Ref 5)
- . provisional guidelines for source emissions (Ref 5)
- . zero tolerance limits in water (Ref 3)
- . provincial water quality objectives (Ref 3)
- . drinking water quality objectives (Ref 2)
maximum acceptable concentration
- . guidelines for human consumption of fish (Ref 4)

These standards, guidelines or objectives are defined as follows:

Nomenclature for Air Contaminant Criteria, Standards & Guidelines

In the past, a variety of terms has been employed to describe the stages of development of criteria, standards and guidelines. The consequence of this practice has been the creation of confusion. In an attempt to dispel the confusion existing around terminology used with regard to air contaminants within the Ministry, the following terms will be established for the categories of criteria, standards and guidelines listed.

It should be noted that all air standards or guidelines (point of impingement) used by the Ministry of the Environment are derived from ambient air criteria established on a limiting effects basis (usually in terms of a 24 hr. average concentration). The ambient air criteria and the associated standards and guidelines will be classified according to the following categories:

1. Criteria

- | | | |
|--------------|---|--------------------------------|
| Category I | - | Ambient Air Quality Criteria |
| Category II | - | Tentative Criteria |
| Category III | - | Guideline Criteria |
| Category IV | - | Provisional Guideline Criteria |

2. Point of Impingement (Emission) Standards & Guidelines

- | | | |
|--------------|---|---|
| Category I | - | Standards |
| Category II | - | Tentative Standards |
| Category III | - | Guidelines for Source Emissions |
| Category IV | - | Provisional Guidelines for Source Emissions |

The bases upon which the above categories of standards or guidelines were established, their limitations and use are outlined below:

· Category I - Standards (Point of Impingement)

These values were established with a high degree of confidence on the basis of data availability covering all aspects of the contaminant effect. They have been approved by the Environmental Air Standards Setting Committee, the Advisory Council and Cabinet, and have been officially published in the Ontario Gazette. Standards are used for compliance for both existing abatement action and new source approval. In any appeal action of a Director's Order, or denial of a Certificate of Approval, the applicability of these standards is not open to question. (However, timing, economics, etc. may be argued in an Appeal).

· Category II - Tentative Standards

Sufficient data are considered available in this category to produce firm standards. The tentative standards proposed have been approved by the Environmental Air Standards Setting Committee or by both the Committee and the Advisory Council, but have not yet received official approval nor have they been published in O. Reg. 15. Tentative standards can be used for abatement action (e.g. Director's Orders) and for the assessment of applications for Certificate of Approval in much the same manner as full fledged standards. However, in any Appeal (to the Environmental Appeal Board) from a Denial or a Director's Order, these values may be questioned with regard to their appropriateness.

Category III - Guidelines

The lack of data on one or more aspects of the contaminants in this category prevents recommendations of firm standards. However, the available data is considered adequate enough to justify the setting of limit values with some confidence. Under these circumstances the recommended values are treated and passed by the Environmental Air Standards Setting Committee as guidelines.

Guidelines will be issued by the Chairman of the Standards Setting Committee to the interested branches of the Ministry for use in abatement action or in the granting of conditional Certificates of Approval, subject to re-assessment when the official standards are produced. Again, in any appeal action the applicability of the guideline values may be questioned.

Category IV - Provisional Guidelines

In this category these air contaminants are lacking definitive data in several important aspects and extensive time will be required to obtain the necessary information. Nevertheless, a working value is urgently needed. The Chairman of the Standards Setting Committee will recommend provisional guidelines (1/2 hr. ave.) based on initial response from the Environmental Health Studies Section and any other data which may be obtained on short notice. The values produced can be used in abatement action or in the granting of conditional Certificates of Approval, subject to re-assessment when the official standards are produced. As in the previous category, in any appeal action, the applicability of these guideline values may be questioned.

SUBSTANCES WITH ZERO TOLERANCE LIMITS

It has been established that the substances with zero tolerance limits, listed in Table 6, if released in any concentration can bio-accumulate or concentrate in the aquatic environment to levels which are harmful or lethal to organisms. To provide long-term protection to aquatic organisms and man, any release of these substances should be completely eliminated. However, it is recognized that trace concentrations of these substances may be found in municipal effluents and other sources and may not be completely removed by current practicable technology; further, some contaminants such as mercury, may occur in surface waters due to natural conditions. Accordingly, the intent of this policy is to prohibit any new discharges of these substances and to reduce all existing releases to the lowest practicable levels.

Although Provincial Water Quality Objectives are specified in Table 6 for some of the substances with zero tolerance limits, the objectives are intended as guidance for dealing with past releases or accidental losses, but not for new releases.

PROVINCIAL WATER QUALITY OBJECTIVES

The Provincial Water Quality Objectives are a set of narrative and numerical criteria designed for the protection of aquatic life and recreation in and on the water. They represent a desirable level of water quality that the Ministry strives to maintain in surface waters of the Province. They are often the starting point in deriving waste effluent requirements.

DRINKING WATER QUALITY OBJECTIVES
MAXIMUM ACCEPTABLE CONCENTRATION (MAC)

This term is used for limits applied to substances for which there are known or suspected adverse health effects. The presence in a drinking water of a substance at a level in excess of its maximum acceptable concentration shall be grounds for rejection of the water unless effective treatment is available. The length of time the maximum acceptable concentration can be exceeded without injury to health will depend on the nature and concentration of the contaminant; however, no drinking water can be permitted to exceed these limits continuously.

GUIDELINES FOR HUMAN CONSUMPTION OF FISH

These safe consumption guidelines are established by Health and Welfare Canada and are adopted by the Province of Ontario.

REFERENCES

- (1) Ontario. 1978. Schedule 1: Extracted from Regulation 15 Revised Regulations of Ontario, 1970 as made by O. Reg. 873/74 and amended by O. Reg. 271/77. J.C. Thatcher, Queen's Printer for Ontario, Toronto.
- (2) Ontario, Ministry of the Environment, 1982. Ontario drinking water objectives. To be published, Ministry of the Environment, Toronto.
- (3) Ontario, Ministry of the Environment, 1978. Water management: Goals, policies, objectives and implementation procedures of the Ministry of the Environment. Ministry of the Environment, Toronto.
- (4) Ontario, Ministry of the Environment and Ministry of Natural Resources. 1982. Guide to eating Ontario Sport fish: Southern Ontario Great Lakes. Ministry of the Environment, Toronto: 158-168.
- (5) Ontario, Ministry of the Environment, Air Resources Branch. 1982. "List of tentative standards, guidelines and provisional guidelines for air contaminants." (Ministry of the Environment, Air Resources Branch, Toronto).
- (6) Ontario, Ministry of the Environment, Air Resources Branch, Environmental Air Standard Setting Committee. "Proceedings." Unpublished.

SUBSTANCES FOR CONSIDERATION† FOR WHICH STANDARDS, GUIDELINES OR OBJECTIVES HAVE BEEN SET BY THE ONTARIO MINISTRY OF THE ENVIRONMENT

TABLE 6	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
acrylamide	45/15							
* acrylonitrile	2,200/750							
aldrin/dieldrin						0.001	0.0007	
* antimony	75/25							
* asbestos			5/0.04 (2)					
* arsenic (total)		15/5 (9)				100	0.05	
arsine	10/5							
barium			30/10				1.0	
* benzene	10,000/3,300							
* beryllium	0.03/0.01					11		
* biphenyl			60/60 (1)					
boron	100						5.0	

† for completeness this table includes pesticides

(1) 1 hr average

(2) Fibres /cc

(9) under review

* Chemicals listed on the List of Chemicals for Further Evaluation are flagged by an asterisk preceding the chemical name.

A/B

A = 1/2 hr average at receptor

B = 24 hr average is understood to mean a 24 hour ambient air objective or criterion unless otherwise specified

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
bromacil			30/10					
butyl acrylate			100/100 (11)					
butyl stearate			100/14,000 (11)					
* cadmium (total)	5.0/2					0.2	0.005	
carbaryl							0.07	
* carbon tetrachloride	20,000/ 7,000							
cellosolve acetate			100/5000(11)					
chlordane						0.06	0.007	
chlorine dioxide	85/30							
* chromium (total)	30/10					100	0.05	

(11) These compounds are normally either solids or liquids at S.T.P. Under these circumstances the existing standard for suspended particulate would over-ride other considerations in setting a standard or guideline.

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
* chloroform			1500/500				See trihalomethanes	
* copper	100/50					5		
* cresols	230/75							
* cyanide (total free)						5	0.2	
* cyclohexane			300,000/ 100,000					
2-4 D							0.1	
DDT					X	0.003	0.03	5.0
decaborane	50/25							
diazinon			9/3				0.014	
diborane	20/10							
* dibutyl phthalate						4.0		
dibutyltin dilaurate			100/30					
dicapryl phthalate	100/500 (11)					0.2 (6)		

(6) specified in Reference 3 as "other phthalates"

(11) these compounds are normally either solids or liquids at S.T.P. Under these circumstances the existing standard for suspended particulate would over-ride other considerations in setting a standard or guideline.

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
* diethylhexylphthalate						0.6		
difluorodichloromethane			1.5 x 10 ⁶ / 0.5 x 10 ⁶					
dimethylether			2100/2100					
* dioctyl phthalate	100/500 (11)					0.2 (6)		
endrin						0.002	0.0002	
ethyl alcohol			19,000/19,000 (1)					
ethyl benzene	4,000							
ethylene		160/40						
* ethylene oxide	28,500/ 9,500							
2-ethyl hexanol			600/600 (1)					
fentanyl citrate				0.06/0.02				
* fluoride	4.3/0.86						2.4	

(1) 1 hr average

(6) specified in Reference 3 as "other phthalates"

(11) these compounds are normally either solids or liquids at S.T.P. Under these circumstances the existing standard for suspended particulate would over-ride other considerations in setting a standard or guideline.

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
* formaldehyde	65/65 (1)							
formic acid	1,500/500							
furfuryl alcohol	3,000/ 1,000							
heptachlor + heptachlor epoxide						0.001	0.003	
hexane			35,000/12,000					
hydrogen cyanide	1,150/575							
hydrogen sulfide	30/30 (1)					2		
isopropyl benzene				100/100 (1)				
* lead	10/5	3.0(12)				5 (3)	0.05	
lithium	60/20							
lithium hydrides	7.5/2.5							
lindane						0.01	0.004	

(1) 1 hr average

(12) 30 day average

(3) dependent on water alkalinity (concentration for lower test alkalinity, 20 mg/L quoted)

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
magnesium oxide	100/50							
malathion			100/300			0.1		
maleic anhydride			100/30					
manganese	100/50							
mercapto benzothiazole disulfide			100/100					
* mercury (total)	5.0/2.0				X	0.2 (dissolved)	0.001	0.5 (7)
* mercury (alkyl)	1.5/0.5							
methacrylic acid			2000/2000(1)					
methane diphenyl di-isocyanate		3/1						
methoxychlor			100/100			0.04	0.1	
methyl bromide	12,000/ 4,000							
* methyl chloride			20000/7000					
* methylene chloride	100,000/ 100,000 (1)							

(1) 1 hr average

(7) in methylmercury form in fish flesh

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
m.e.k. peroxide			250/80					
* 4,4 methylene-bis-2 chloroaniline			30/10					
methylene dianiline			3/1					
methyl parathion							0.007	
* mirex					X	0.001		0.1
alpha-naphthol			100/100					
* naphthalene								
* nickel	5/2					25		
* nickel carbonyl	1.5/0.5							
nitrilotriacetic acid (NTA)	100/100						0.05	

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
parathion						0.008	0.035	
pentaborane	3.0/1							
* pentachlorophenol			60/20					
* perchloroethylene			10,000/4,000					
* phenol	100/100(1)					1		
* phosgene	130/45							
phosphorous pentachloride			30/10					
phthalic anhydride	100/500							
* PBB's					X			
* PCB's			0.450/0.150 35ng (annual)		X	0.001	0.003 (4)	2.0
* PCD's								20ppt (5)

(1) 1 hr average

(4) Interim

(5) for 2,3,7,8 - TCDD

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
polychloroprene			100/500					
N-propyl alcohol			48,000/16,000					
propylene oxide	78,000/ 26,000							
radionuclides - radium-226 cesium-137 strontium-90 tritium iodine-131						1 Bq/L(10) 50 Bq/L 10 Bq/L 40,000 Bq/L 10 Bq/L	1 Bq/L 50 Bq/L 10 Bq/L 40,000 Bq/L 10 Bq/L	
respirable silica			15/5					
* selenium			20/10			100	0.01	
* silver	3/1					0.1	0.05	
* styrene	400/400(1)							
talc (fibrous)			5/2					
tellurium	30/10							
tetrahydrofuran	93,000/31,000							

(1) 1 hr average

(10) Bq/L - Becquerel/Liter

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
tetramethylthiuram disulphide			30/10					
tin	30/10							
titanium	100/1000							
* toluene	2,000/2,000(1)							
toluene diisocyanate	1.0/0.5							
toxaphene						0.008	0.005	
2,4,5 TP							0.01	
* 1,2,4-trichlorobenzene			100/400					
* trichloroethylene	85,000/28,000							
trifluorotrichloro (1,1,2) ethane	2.4 x 10 ⁶ /80,000							
trihalomethanes							0.35 (8)	
1,2,4-trimethylbenzene			100/1,000					

(1) 1 hr average

(8) total concentration of all trihalomethanes

TABLE 6 (continued)

	AIR				AQUATIC			
	STANDARDS (UG/M ³) A/B	TENTATIVE STANDARDS (UG/M ³) A/B	GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	PROVISIONAL GUIDELINES FOR SOURCE EMISSIONS (UG/M ³) A/B	ZERO TOLERANCE LIMIT	PROVINCIAL WATER QUALITY OBJECTIVES (UG/L)	DRINKING WATER OBJECTIVES MAXIMUM ACCEPTABLE CONCENTRA- TION (MG/L)	GUIDELINES FOR HUMAN CONSUMPTION OF FISH (ppm)
tripropyltin methacrylate			3/1					
uranium							0.02 (4)	
* vanadium	5.0/2							
* vinyl chloride			560/280					
* vinylidene chloride	26,000/ 8,600							
* xylenes	2,300/ 2,300(1)							
* zinc	100/500					30		

(1) 1 hr average

(4) Interim

FUTURE CONSIDERATIONS

This report details the chemical assessment process developed by this Ministry and the identification of chemicals that require further evaluation. Exposure and effects information is currently being gathered and a hazard assessment process is under study. The overall hazard assessment process will be coordinated by the Hazardous Contaminants Office with the technical aspects of the process being developed and implemented by the branches of the Ministry. In addition, it must be understood that chemical assessment is a multi-jurisdictional and multi-organizational task and only through co-operative efforts and liaison will an overall understanding in this area be achieved.

It is the intent of the Hazardous Contaminants Office to publish the results of future Ministry developments and to provide an annual update on the status of chemicals on the List of Chemicals for Consideration.

APPENDIX I
CHEMICAL LISTS SELECTED FOR THE
LIST OF CHEMICALS FOR CONSIDERATION

REVISED PRIORITY CHEMICAL LIST, JUNE 1979, HAZARDOUS CONTAMINANTS
TECHNICAL COMMITTEE, ONTARIO MINISTRY OF THE ENVIRONMENT

The purpose of this list was to bring to attention those substances which are most likely to be hazardous when released into the environment. The chemicals were divided into three categories:

Regulated Hazardous Compounds,

Potentially Hazardous Compounds, and

Surveillance Compounds.

Reference(s):

Ontario, Ministry of the Environment, Hazardous Contaminants
Technical Committee. 1979. "Revised priority chemicals
list, June 1979." Ministry of the Environment, Toronto.

**WATER MANAGEMENT - GOALS, POLICIES, OBJECTIVES AND IMPLEMENTATION
PROCEDURES OF THE ONTARIO MINISTRY OF THE ENVIRONMENT.**

This list consists of those substances or group of substances for which the following objectives, limits or criteria were documented:

- (1) Provincial Water Quality Objectives
- (2) Substances with Zero Tolerance Limits
- (3) Substances with Undefined Tolerance Limits
- (4) Drinking Water Quality Criteria
- (5) Water Quality Criteria for Agricultural Uses.

Reference(s):

Ontario, Ministry of the Environment. 1978. Water Management: Goals, policies, objectives and implementation procedures of the Ministry of the Environment. Ministry of the Environment, Toronto.

ONTARIO INVENTORY FOR SPECIFIED CHLORINATED AND AROMATIC HYDROCARBONS: ONTARIO MINISTRY OF THE ENVIRONMENT.

The inventory was commissioned by the Ontario, Ministry of the Environment with the objective of preparing a province-wide quantity/location inventory and an emission/discharge inventory, for specified chlorinated and aromatic hydrocarbons. The inventory is used to evaluate potential population exposures resulting from the specified hydrocarbons.

Reference(s):

Ontario, Ministry of the Environment, Air Resources Branch, Hazardous Contaminants Programme. 1978. Environmental aspects of selected aromatic hydrocarbons in Ontario: A comprehensive background report. Ministry of the Environment, Toronto.

Idem. 1978. Environmental aspects of selected chlorinated hydrocarbons in Ontario: A comprehensive background report. Ministry of the Environment, Toronto.

Idem. 1980. Ontario inventory for specified chlorinated and aromatic hydrocarbons. Acres Consulting Services Limited, for the Ministry of the Environment, Toronto.

LIST OF STANDARDS, TENTATIVE STANDARDS, GUIDELINES AND
PROVISIONAL GUIDELINES FOR AIR CONTAMINANTS, ONTARIO MINISTRY OF
THE ENVIRONMENT.

This list consists of air contaminants for which standards,
tentative standards, guidelines or provisional guidelines have
been established.

Reference(s):

Ontario. 1978. Schedule 1: Extracted from Regulation 15 Revised
Regulations of Ontario, 1970 as made by O. Reg. 873/74 and
amended by O. Reg. 271/77. J.C. Thatcher, Queen's Printer
for Ontario, Toronto.

Ontario, Ministry of the Environment, Air Resources Branch.
1982. "List of tentative standards, guidelines and
provisional guidelines for air contaminants: as of January
1982." Air Resources Branch, Toronto.

SUBSTANCES FOUND IN THE GREAT LAKES BASIN, GREAT LAKES WATER
QUALITY BOARD, INTERNATIONAL JOINT COMMISSION.

This list consists of 381 compounds and classes of compounds that
have been identified in the Great Lakes Basin.

Reference(s):

International Joint Commission, Great Lakes Water Quality Board,
Implementation Committee. 1977. Great lakes water quality:
Status report on the persistent Toxic pollutants in the Lake
Ontario basin; Appendix E. International Joint Commission,
Windsor, Ontario.

Konasewich, D., W. Traversy, and H. Zar. 1978. Great Lakes
water quality: Status report on organic and heavy metal
contaminants in the Lakes Erie, Michigan, Huron and Superior
basins; Appendix E. International Joint Commission, Great
Lakes Water Quality Board, Windsor, Ontario.

**PRIORITY AND CANDIDATE CHEMICALS, ENVIRONMENTAL CONTAMINANTS ACT,
ENVIRONMENT CANADA AND HEALTH AND WELFARE CANADA**

The List included those substances for which regulations were being developed under the Environmental Contaminants Act or about which further information was required to determine whether regulation or other action was necessary.

It is intended that the priority and candidate chemicals lists comprise principally chemical substances that are imported into Canada or manufactured or processed in this country. The Environmental Contaminants Act is capable of regulating the importation, manufacture and processing of any chemical substance that poses a threat to human health or the environment. Chemicals that are used solely as drugs, food additives or pesticides are arbitrarily excluded from consideration because they are already scrutinized or controlled under other federal legislation.

The Department of the Environment has embarked on a comprehensive program to coordinate its research, surveys and control actions on a broad range of chemical compounds. Thus this year's announcement makes no further mention of several important environmental contaminants such as arsenic, asbestos, benzene, lead, nitrogen and sulphur oxides or polynuclear aromatic hydrocarbons, because they are being investigated or controlled under legislative mandates other than the Environmental Contaminants Act.

The same three criteria announced in the December 1, 1979 Canada Gazette notice that pertain to the hazards posed by a chemical substance to human health or the environment were applied to the selection of chemicals for this year's List. These criteria encompass the several properties of a chemical substance, e.g., carcinogenicity, mutagenicity, teratogenicity, toxicity, volatility, solubility, routes of entry into the environment, dispersion and distribution throughout the environment, nature of transformation products, impurities, persistence, accumulation in tissues and amounts imported, manufactured or processed. The three criteria are:

- (1) **Toxic effects criterion.** Evaluation of scientific data leads to the conclusion that the chemical substance could cause or causes adverse effects on human health or the environment.
- (2) **Persistence criterion.** Evaluation of scientific data leads to the conclusion that the chemical substance accumulates or could accumulate to significant concentrations in air, water, soil, sediment or tissue.
- (3) **Quantity and use criterion.** Evaluation of available data on the importation, manufacture or processing of a chemical substance leads to the conclusion that the substance is in commerce and thus could enter or has entered the environment in significant quantities.

LIST OF PRIORITY CHEMICALS

The most recently revised List of Priority Chemicals, which supersedes previous Lists of Priority Chemicals, is presented below with a description of each category.

CATEGORY I: Those substances which the government is satisfied pose a significant danger to human health or the environment and for which regulations or specific control strategies are being developed.

CATEGORY II: Those substances which are being investigated to determine the nature and the extent of the danger to human health or the environment and the appropriate means to alleviate that danger.

CATEGORY III: Those substances which may pose a significant danger to human health or the environment and about which further detailed information (for example toxicology and amounts used) is required.

CANDIDATE CHEMICALS

In 1979 a second list of chemicals entitled Candidate Chemicals, was drawn up for the purpose of specifically evaluating potential environmental contamination problems. The data for substances on this List were generally weak. In order to obtain more detailed information on commercial use patterns of these substances,

notices under sections 3(1) and 4(1)(b) of the Environmental Contaminants Act have been issued. Following review of the available data and of the results of the information gathering exercise that are expected by early 1981, some of the substances may warrant detailed investigation and may be placed on the List of Priority Chemicals or may not warrant further investigation and be deleted from the List.

Reference(s):

Canada, Department of the Environment and Department of National Health and Welfare. 1980. "Environmental Contaminants Act: Priority and candidate chemicals schedule to Environmental Contaminants Act," The Canada Gazette, Part I 114 (48): 7239-7244.

- (1) **Critical Materials Register, and Air Priority Chemicals List, Michigan Department of Natural Resources, Michigan, U.S.A.**

Critical Materials Register

Pursuant to Act 293, P.A. 1972, an amendment to Act 245, P.A. 1929, the Michigan Water Resources Commission was authorized to develop a Register of Critical Materials which are or may be used and/or discharged in Michigan. The development of the Register is based on extensive review of the scientific literature on physical, chemical, and toxicological properties of industrial, pharmaceutical and agricultural chemicals. Advice on establishment and subsequent revisions of the Register comes from an advisory committee composed of environmental specialists from academia, industry, government, and special interest groups. Chemicals selected for review include chemicals with well recognized high toxicity (e.g. PCB's, mercury, cyanide, etc.), those from various lists of priority chemicals developed by NIOSH, EPA, etc., and chemicals of specific concern in Michigan. The review process utilizes a hazard assessment methodology which considers acute toxicity, carcinogenicity, mutagenicity, teratogenicity, persistence, bioaccumulation, and other adverse effects (including subacute and chronic toxicity, feto- or embryotoxicity, phytotoxicity and aesthetics). Chemicals are numerically scored as to their hazard and those posing a high environmental concern (i.e. high score) are included in the Register. The Register is revised and updated annually as additional information about these chemicals becomes available.

Every business within the State using Critical Materials and discharging to the waters of the State or discharging process waste in addition to sanitary waste to a sewer system must file an annual report on Critical Materials use and discharge. This information is then used for protection of the environment and human health through water pollution control programs.

Air Priority Chemicals List

The objective of the program is to develop a list of chemicals which would be of high concern if introduced into the atmosphere. This list, which is known as the Air Priority Chemicals List (APCL), is composed of those chemicals included on Michigan's Critical Materials Register (CMR) plus a set of chemicals which are of concern specifically from an inhalation toxicity standpoint. The APCL and the methodology for its development is basically a subset of the Michigan Critical Materials Register and Chemical Hazard Assessment approach and therefore also includes those chemicals which are of high concern in the terrestrial and aquatic environment because of the eventual fallout of emitted substances to land and water. Commercial, industrial, or governmental entities which have emissions to the air are required to report use and emission of those substances on the Air Priority Chemicals List on an annual basis. Those facilities reporting critical materials for wastewater reporting purposes are required to report only those chemicals unique to the Air Priority Chemicals List. The purpose of this program is to develop the capability of anticipating and

identifying potential problems involving air emissions before these problems develop into crises. Essentially, development and implementation of this program follows along the lines already established for the Critical Materials Register program.

Reference(s):

Michigan, Department of Natural Resources, Environmental Protection Bureau, Environmental Services Division. 1980. Critical materials register. Department of Natural Resources, Lansing, Michigan.

Idem. 1981. Critical Materials Register: Addendum. Department of Natural Resources, Lansing, Michigan.

Idem. 1980. Michigan air priority chemicals list. Department of Natural Resources, Lansing, Michigan.

PRIORITY POLLUTANT LIST, U.S. ENVIRONMENTAL PROTECTION AGENCY

Under Section 307 of the Clean Water Act the Administrator (EPA) shall publish a list which includes any toxic pollutant or combination of such pollutants for which an effluent standard will be established under this section. The administrator in publishing such list shall take into account the toxicity of the pollutant, its persistence, degradability, the usual or potential presence of the affected organisms and the nature and extent of the effect of the toxic pollutant on such organisms.

Reference(s):

United States, Congress. 1979. The Clean Water Act showing changes made by the 1977 amendments and the 1978 amendments to sections 104 and 311. U.S. Government Printing Office, Washington D.C.: 64-68.

United States, Environmental Protection Agency. 1978.

"Publication of toxic pollutant list." Federal Register 43(21): 4108-4109.

**CHEMICALS RECOMMENDED TO THE U.S. ENVIRONMENT PROTECTION AGENCY
FOR FURTHER TESTING BY THE U.S. INTERAGENCY TESTING COMMITTEE**

There is established a committee to make recommendations to the Administrator (EPA) respecting the chemical substances and mixtures to which the Administrator should give priority consideration. In making such a recommendation with respect to any chemical substance or mixture, the committee shall consider all relevant factors, including:

- (i) the quantities in which the substance or mixture is or will be manufactured,
- (ii) the quantities in which the substance or mixture enters or will enter the environment,
- (iii) the number of individuals who are or will be exposed to the substance or mixture in their places of employment and the duration of such exposure,
- (iv) the extent to which human beings are or will be exposed to the substance or mixture,
- (v) the extent to which the substance or mixture is closely related to a chemical substance or mixture which is known to present an unreasonable risk or injury to health or the environment,

- (vi) the existence of data concerning the effects of the substance or mixture on health or the environment,
- (vii) the extent to which testing of the substance or mixture may result in the development of data upon which the effects of the substance or mixture on health or the environment can reasonably be determined or predicted, and
- (viii) the reasonably foreseeable availability of facilities and personnel for performing testing on the substance or mixture.

The recommendations of the committee shall be in the form of a list of chemical substances and mixtures which shall be set forth, either by individual substance or mixture or by groups of substances or mixtures, in the order in which the committee determines the Administrator should take action with respect to the substances and mixtures. In establishing such list, the committee shall give priority attention to those chemical substances and mixtures which are known to cause or contribute to or which are suspected of causing or contributing to cancer, gene mutations, or birth defects. The committee shall designate chemical substances and mixtures on the list with respect to which the committee determines the Administrator should, within 12 months of the date on which such substances and mixtures are first designated, initiate a proceeding. The total number of chemical substances and mixtures on the list which are designated under the preceding sentence may not, at any time, exceed 50.

Reference(s):

United States, Congress. 1976. An act to regulate commerce and protect human health.... Public Law 94-469: 90 Stat. 2010-2012.

United States, Environmental Protection Agency. 1981. "Eighth report of the Interagency Testing Committee to the administrator; requests for comments regarding priority list of chemicals." Federal Register 46(99): 28132-28144.

CHEMICALS FOR REVIEW BY THE U.S. INTERAGENCY TESTING COMMITTEE

This list consists of chemicals which will be reviewed by the ITC during the next 18-24 months for possible recommendation to the U.S. Environmental Protection Agency for further testing. The ITC arrives at this list by a scoring exercise which takes into consideration the likelihood that a given chemical may present an unreasonable risk of injury to health or the environment and the extent to which health or environmental hazards may be expected, based upon structure activity relationships by extrapolation from chemicals for which such hazards have been characterized.

Reference(s):

"1980 List of chemicals selected for review by the TSCA

Interagency Testing Committee." 1980. Chemical Regulation Reporter 4(30): 953-956.

United States, Toxic Substances Control Act Interagency Testing Committee. 1980. "Chemicals to be reviewed by the TSCA Interagency Testing Committee: Public meeting." Federal Register 45(196): 66506-66507.

**Hazardous Substances, U.S. Interagency Regulatory Liaison Group.
(IRLG)**

This group formed in 1977, consists of four U.S. federal agencies -- the Consumer Product Safety Commission (CPSC), the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA) and the Occupational Safety and Health Administration. The IRLG established the Regulatory Development Working Group to identify hazardous materials that two or more agencies planned to investigate for possible regulation. In December 1978, the IRLG published development plans for 24 hazardous substances.

Reference(s):

United States, Environmental Protection Agency. 1977.

"Regulation of toxic and hazardous substances: Interagency agreement". Federal Register 42(196): 54856-54857.

United States, Interagency Regulatory Liaison Group. 1979.

Regulatory Reporter. United States Government Printing Office for the Environmental Protection Agency, Washington D.C.; (semi-annual).

LIST OF SUBSTANCES WHICH MAY BE CANDIDATES FOR FURTHER SCIENTIFIC REVIEW AND POSSIBLE IDENTIFICATION, CLASSIFICATION, AND REGULATION AS POTENTIAL OCCUPATIONAL CARCINOGENS, U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA).

OSHA has published a list of substances which may be considered candidates for further scientific review and possible identification, classification, and regulation as potential occupational carcinogens. This listing of substances which is required by the OSHA standard for the identification, classification, and regulation of potential occupational carcinogens does not mean that OSHA has determined that a substance on the list is carcinogenic or that regulatory action on the substance is necessary, nor is such a listing intended as a preclassification warning. It is OSHA's view that the compilation and publication of the list of substances accomplishes the following: informs the public at the very first step in OSHA's standard-setting process that a substance is a candidate for closer scientific review; makes available to the public the data base for substances OSHA is considering for further scientific review; reduces the number of substances to be subjected to such a review; guides the research community in focusing its resources on those substances for which there is a need for testing and further research; stimulates early public comment regarding the availability and appropriateness of new or additional scientific data; and, overall, assists OSHA in its setting of priorities and selecting of substances for regulation.

Reference(s):

United States, Department of Labor, Occupational Safety and Health Administration. 1980. "List of substances which maybe candidates for further scientific review and possible identification, classification, and regulation as potential occupational carcinogens." Federal Register 45(157): 53671-53679.

APPENDIX II

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT

As a preliminary environmental and human health effects assessment of the chemicals on the List of Chemicals for Further Evaluation this Ministry has initially accepted the assessment and scoring process developed by the Department of Natural Resources, Environmental Services Division, State of Michigan. A complete description of the Michigan assessment criteria and rationale for the Air Priority Chemicals List is attached. It should be noted that the assessment criteria for the Air Priority Chemicals List differ from the criteria used in the Critical Materials Register which is water based and the reader is urged to read the original publications.

The List of Chemicals for Further Evaluation, listed by Group Classification, is scored using the Michigan Air Priority Chemicals List and the Michigan Critical Register (aquatic) as provided by Michigan State, Table 3. It should be noted that this listing includes those chemicals on the List of Chemicals for Further Evaluation that were assessed and received total scores of less than seven. Table 4 lists in decreasing numerical order the total scores of those chemicals from Table 3 that were assessed.

Reference(s):

Michigan Department of Natural Resources, Environmental
Protection Bureau, Environmental Services Division. 1980.
Critical materials register. Department of Natural
Resources, Lansing, Michigan.

Idem. 1982. "Hazard assessment report: Form 1." Computer
printout, 30 April 1982.

Idem. 1981. Critical Materials Register: Addendum. Department
of Natural Resources, Lansing, Michigan.

Idem. 1980. Michigan air priority chemicals list. Department
of Natural Resources, Lansing, Michigan.

APCL HAZARD ASSESSMENT PROCESS

The hazard assessment process used to include chemicals on the APCL is essentially an expansion of the CMR hazard assessment methodology with the addition of the inhalation route of exposure to the criteria to take into account inhalation toxicity. The APCL hazard assessment process is a priority ranking-point assignment system used to evaluate compounds for possible inclusion on the APCL. This system is summarized on the APCL Hazard Assessment Sheet (Table 1). The goal of this approach is to increase the objectivity of the hazard assessment process and to better balance the degree of emphasis placed on each factor considered. Factors of environmental concern for potentially deleterious substances are separated into seven specific areas: 1) acute toxicity, 2) carcinogenicity, 3) hereditary mutagenicity, 4) teratogenicity, 5) persistence, 6) bioaccumulation, and 7) other adverse effects (including subacute and chronic effects to terrestrial and aquatic life, phytotoxicity and aesthetics). Adverse effects of metabolites or degradation products are evaluated as properties of the parent chemical. Should these metabolites or degradation products meet the criteria for placement on the register, the parent compound is included on the APCL.

Each category within the seven individual factors has been assigned a point value commensurate with its level of environmental concern in keeping with the overall objectives of

the program. A score of seven points in one factor or a cumulative score of seven or more points in several factors will include a chemical on the APCL. The scoring factors can be adjusted to reflect changing priorities or objectives, and to control the final composition of the list. The factors which potentially have the most severe adverse impacts on the environment and human health (acute toxicity, carcinogenicity, hereditary mutagenicity, teratogenicity, bioaccumulation and low dose adverse effects) may receive a maximum score of seven. Those factors which can receive a score of seven represent a very high level of concern and are restrictively defined in the Criteria and Rationale. Other factors which are of relatively lower concern receive correspondingly lower point values and are less restrictively defined in the criteria.

The actual process of scoring the chemical on the Hazard Assessment Sheet is carefully and accurately conducted to insure the integrity of the program. Each factor in the Hazard Assessment Process is scored for all the chemical substances reviewed. All available data is fully evaluated to determine their validity, and the proper scoring factor and category. Often, the original research publications must be obtained before a decision can be made. Staff of the DNR or members of the Michigan Critical Materials Register Advisory Committee may then make decisions on the adequacy of the testing methods, statistical analyses, and data interpretation.

The chemical, benzene, is scored in Table 2.

TABLE 1: AIR PRIORITY CHEMICALS LIST HAZARD ASSESSMENT SHEET

OFFICIAL ABSTRACT NUMBER

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 TOTAL SCORECOMMON CHEMICAL NAME _____
CHEMICAL ABSTRACT NAME _____

SCORE

I. ACUTE TOXICITY

SCORE	ORAL LD50 MG/KG	DERMAL LD50 MG/KG	AQUATIC 96 HR LC50 MG/L	INHALATION (≤ 4 HR) LC50 UG/L
7	<5	<5	<1	< 500
3	5-50	5-200	1-10	500-2000
2	> 50-500	> 200-500	> 10-100	> 2000-20000
1	>500-5000	> 500-5000	> 100-1000	> 20000-50000
0	> 5000	> 5000	> 1000	> 50000
*	INSUFFICIENT INFORMATION			

II. CARCINOGENICITY

SCORE	CATEGORY
7	HUMAN POSITIVE
3	POTENTIAL ANIMAL
2	CARCINOGENIC BY A ROUTE OTHER THAN ORAL, DERMAL, OR INHALATION
1	STRONGLY SUSPECT CARCINOGEN BY ACCEPTED MUTAGENICITY SCREENING TESTS
0	SUSPECT CARCINOGEN BY ACCEPTED MUTAGENICITY TESTS
0	NOT CARCINOGENIC
*	INSUFFICIENT INFORMATION

III. HEREDITARY MUTAGENICITY

SCORE	CATEGORY
7	CONFIRMED
4	SUSPECT (MULTICELLULAR ORGANISMS)
2	SUSPECT (MICRO-ORGANISMS)
0	NOT A HEREDITARY MUTAGEN
*	INSUFFICIENT INFORMATION

IV. TERATOGENICITY

SCORE	CATEGORY
7	CONFIRMED
3	POTENTIAL
0	NOT TERATOGENIC
*	INSUFFICIENT INFORMATION

V. PERSISTENCE

SCORE	CATEGORY	T's IN WEEKS (SOIL, WATER, AIR)
4	VERY PERSISTENT	> 52
3	PERSISTENT	40 - 52
2	SLOWLY DEGRADABLE	27 - 39
1	MODERATELY DEGRADABLE	14 - 26
0	READILY DEGRADABLE	0 - 13
*	INSUFFICIENT INFORMATION	

VI. BIOACCUMULATION

SCORE	BIOACCUMULATION	LOG P
7	> 4000	> 6.00
3	1000 - 3999	5.00 - 5.99
2	700 - 999	4.50 - 4.99
1	300 - 699	4.00 - 4.49
0	< 300	< 4.00
*	INSUFFICIENT INFORMATION	

VII. OTHER ADVERSE EFFECTS

A. TERRESTRIAL AND AQUATIC

SCORE	CATEGORY
7	INDUSTRIAL
3	IRREVERSIBLE EFFECTS, VERY LOW DOSE
2	IRREVERSIBLE EFFECTS
1	REVERSIBLE EFFECTS
0	NO DETECTABLE ADVERSE EFFECTS
*	INSUFFICIENT INFORMATION

B. PLANT

SCORE	GAS/VAPOR (PPM)	WATER (MG/L)
3	< 1	< 0.5
2	1 - 10	0.5 - 5
1	> 10 - 100	> 5 - 50
0	> 100	> 50
*	INSUFFICIENT INFORMATION	

C. AESTHETICS

SCORE	ESTIMATED THRESHOLD LEVEL IN WATER (MG/L) TAINTING OF FISH AND/OR TASTE & ODOR	FOAMING PROPERTIES AND/OR PRODUCES FLOATING, FILM AND/OR IMPARTS MAJOR COLOR CHANGE TO WATER	PRODUCES AN OBJECTABLE ODOR IN AIR (PPM)
1	≤ 0.001	YES	≤ 0.0001
0	> 0.001	NO	> 0.0001
*	INSUFFICIENT INFORMATION		

TABLE 2:

AIR PRIORITY CHEMICALS LIST HAZARD ASSESSMENT SHEET

COMMON CHEMICAL NAME Benzene

CHEMICAL ABSTRACT NAME _____

(scores are underlined)

SCORE

I. ACUTE TOXICITY

2

SCORE	ORAL LD50 MG/KG	DERMAL LD50 MG/KG	AQUATIC 96 HR LC50 MG/L	INHALATION (< 4 HR) LC50 UG/L
7	<5	<5	<1	< 500
3	5-50	5-200	1-10	500-2000
2	> 50-500	> 200-500	> 10-100	> 2000-20000
T	>500-5000	> 500-5000	> 100-1000	> 20000-50000
0	> 5000	> 5000	> 1000	> 50000
*	INSUFFICIENT INFORMATION			

II. CARCINOGENICITY

7-PH

SCORE	CATEGORY
7	HUMAN POSITIVE POTENTIAL HUMAN ANIMAL POSITIVE
3	POTENTIAL ANIMAL
2	CARCINOGENIC BY A ROUTE OTHER THAN ORAL, DERMAL, OR INHALATION
1	STRONGLY SUSPECT CARCINOGEN BY ACCEPTED MUTAGENICITY SCREENING TESTS
0	SUSPECT CARCINOGEN BY ACCEPTED MUTAGENICITY TESTS
0	NOT CARCINOGENIC
*	INSUFFICIENT INFORMATION

III. HEREDITARY MUTAGENICITY

*

SCORE	CATEGORY
7	CONFIRMED
4	SUSPECT (MULTICELLULAR ORGANISMS)
2	SUSPECT (MICRO-ORGANISMS)
0	NOT A HEREDITARY MUTAGEN
*	INSUFFICIENT INFORMATION

IV. TERATOGENICITY

*

SCORE	CATEGORY
7	CONFIRMED
3	POTENTIAL
0	NOT TERATOGENIC
*	INSUFFICIENT INFORMATION

OFFICIAL ABSTRACT NUMBER

0	0	0	7	1	-	4	5	-	2
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 TOTAL SCORE A-11-6*

V. PERSISTENCE

*

SCORE	CATEGORY	T's IN WEEKS (SOIL, WATER, AIR)
4	VERY PERSISTENT	> 52
3	PERSISTENT	40 - 52
2	SLOWLY DEGRADABLE	27 - 39
1	MODERATELY DEGRADABLE	14 - 26
0	READILY DEGRADABLE	0 - 13
*	INSUFFICIENT INFORMATION	

VI. BIOACCUMULATION

*

SCORE	BIOACCUMULATION	LOG P
7	> 4000	> 6.00
3	1000 - 3999	5.00 - 5.99
2	700 - 999	4.50 - 4.99
1	300 - 699	4.00 - 4.49
0	< 300	< 4.00
*	INSUFFICIENT INFORMATION	

VII. OTHER ADVERSE EFFECTS

2-2*

A. TERRESTRIAL AND AQUATIC

SCORE	CATEGORY	AQUATIC (MG/L)
7	INDUSTRIAL	
3	IRREVERSIBLE EFFECTS, VERY LOW DOSE	< 0.1
2	IRREVERSIBLE EFFECTS	0.1 - 1
T	REVERSIBLE EFFECTS	> 1 - 10
0	NO DETECTABLE ADVERSE EFFECTS	> 10 - 100
*	INSUFFICIENT INFORMATION	> 100
		*

B. PLANT

SCORE	GAS/VAPOR (PPM)	WATER (MG/L)
3	< 1	< 0.5
2	1 - 10	0.5 - 5
1	> 10 - 100	> 5 - 50
0	> 100	> 50
*	INSUFFICIENT INFORMATION	

C. AESTHETICS

SCORE	ESTIMATED THRESHOLD LEVEL IN WATER (MG/L) TAINTING OF FISH AND/OR TASTE & ODOR	FOAMING PROPERTIES AND/OR PRODUCES FLOATING, FILM AND/OR IMPARTS MAJOR COLOR CHANGE TO WATER	PRODUCES AN OBJECTABLE ODOR IN AIR (PPM)
1	< 0.001	YES	< 0.0001
0	> 0.001	NO	> 0.0001
*	INSUFFICIENT INFORMATION		

EXPLANATION OF SCORING +

Table 2: continued

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: (see Table 3)

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
Benzene	A-11-6*	2	1	*	2	1	7-PH	*	*	02-2*	2	*	*	*	*	*	00071432	0679

TOTAL SCORES = Sum of Total (TOT) under Acute Toxicity plus Carcinogenicity (CARCN) plus Hereditary Mutagenicity (H.MUT) plus Teratogenicity (TERT) plus TOTAL under Other Adverse Effects plus Persistence (PERS) plus Bioaccumulation (BIOA).

for Benzene, TOTAL SCORE = 2 + 7 + * + * + 02 - 2* + * + * = A-11-6*, the A stands for Air Priority Chemicals List.

I ACUTE TOXICITY

The total score (TOT under Acute Toxicity) is the highest score given to any category (oral, dermal, aquatic or inhalation).

for Benzene, Acute Toxicity Total = 2, (highest of 1, *, 2, 1)

VII OTHER ADVERSE EFFECTS

The total Score (TOTAL) under Other Adverse Effects is the sum of category VII-A: Adverse Terrestrial Effects (ATE) or Adverse Aquatic Effects (AQU) whichever is higher plus category VII-B: Adverse Plant Effects (APE) plus category VII-C: Adverse Aesthetic Effects (AAE).

for Benzene, Other Adverse Effects Total = (2 or *) + * + *
= 2 + 2* (denoted as 2 - 2*)

+ A complete description of the scoring procedure is provided in the section: APCL Hazard Assessment Criteria And Rationale.

APCL HAZARD ASSESSMENT CRITERIA AND RATIONALE

ACUTE TOXICITY

CRITERION:

<u>SCORE</u>		<u>ORAL LD50</u>	<u>DERMAL LD50</u>	<u>AQUATIC 96 HR LC50</u>	<u>INHALATION (\leq 4 HR) LC50 ug/l</u>
7	Extremely Toxic	<5 mg/kg	<5 mg/kg	<1 mg/l	\leq 500
3	Highly Toxic	5-50 mg/kg	5-200 mg/kg	1-10 mg/l	500-2000
2	Moderately Toxic	>50-500 mg/kg	>200-500 mg/kg	>10-100 mg/l	>2000-20000
1	Slightly Toxic	>0.5-5 g/kg	>0.5-5 g/kg	>100-1000 mg/l	>20000-50000
0	Relatively Nontoxic	>5 g/kg	>5 g/kg	>1000 mg/l	>50000
*	Insufficient Information				

RATIONALE:

Classification is based upon generally accepted terminology found in the available literature on acute toxicity. The critical levels describing "highly toxic" for oral, dermal, and aquatic routes of exposure are adapted from Battelle Memorial Institute, National Academy of Sciences, State of California List of Toxic Substances, Federal Water Pollution Control Agency, Pesticides-Title 40, Department of Transportation Title 49, Consumer Product Safety Commission, and the Federal Hazardous Substances Labeling Act Title 15 classifications (EPA, 1978), as well as systems presented by Hodge and Sterner (1949). Levels of "moderate", "slightly" and "relatively nontoxic", as well as all levels for inhalation exposure, are adapted from the National Academy of Sciences (EPA, 1975), Hodge and Sterner (1949) and Gleason, et al (1977).

Data available for each category for each type of exposure (i.e. oral, dermal, inhalation, aquatic) are scored independently. The score assigned to the acute toxicity factor is the highest score given to any individual category. For example, a chemical substance which has an oral LD50 of 5-50 mg/kg, a dermal LD50 of 200-500 mg/kg, an inhalation LC50 of greater than 5000 ug/l, and an aquatic 96 hr LC50 of less than 1 mg/l is assigned a score of seven based on the extreme aquatic toxicity.

REFERENCES:

Cassarett, L.J. and Doull, J. (eds.) 1975. Toxicology, The Basic Science of Poisons. Macmillan Publishing Co., New York, New York. 768 pp.

Gleason, M. N.; Gosselin, R. E.; Hodge, H. C.; and Smith, P. R. 1977. Clinical Toxicology of Commercial Products, 4th Edition. Williams and Wilkins Company. Baltimore, MD.

Hodge, H. C. and Sterner, S. H. 1949. Tabulation of toxicity classes. AIHA Quarterly. 10:93-96.

U.S. Environmental Protection Agency. 1975. A Summary of Hazardous Substance Classification Systems. Solid Waste Management Series (SW-171) EPA/530.

U.S. Environmental Protection Agency. 1978. Initial Report of the TSCA Interagency Testing Committee to the Administrator. EPA 560-10-78/001.

CARCINOGENICITY

CRITERION:

<u>SCORE</u>	<u>CATEGORY</u>
7	The chemical has been demonstrated to be a human positive, potential human, or animal positive carcinogen (defined below) by the oral, dermal or inhalation route of exposure based on data reported by the International Agency for Research on Cancer (IARC), or National Cancer Institute (NCI), or National Institute for Occupational Safety and Health (NIOSH).
3	The chemical has been demonstrated to be a potential animal carcinogen (defined below) by the oral, dermal or inhalation route of exposure.
2	The chemical has been demonstrated to be an animal positive or potential animal carcinogen by any route other than oral, dermal or inhalation, or has been demonstrated by accepted mutagenicity screening tests or accepted cell transformation studies to be a strongly suspect carcinogen (defined below).
1	The chemical has been demonstrated by accepted mutagenicity tests or accepted cell transformation studies to be a suspect carcinogen (defined below).

0 The chemical has been tested by the above systems and has not been demonstrated to cause cancer or to be a suspect carcinogen.

* Insufficient information.

RATIONALE:

Most cancers are believed to be caused by exposure to extrinsic factors, among which chemical agents are thought to be a major contributor. These agents must be identified, evaluated and controlled if the incidence of cancer is to be reduced. An urgent and essential part of the Michigan Air Priority Chemicals Program is the need to protect the public and environment from chemical carcinogenic hazards and their effects. In an effort to meet this need, this carcinogenicity criterion was developed.

In addition to the standard long-term carcinogenicity test, a great deal of research is being conducted to develop rapid test methods. At present, there are two quick test systems that are of most interest, the cell transformation test and the mutagenicity test. The cell transformation test is based on the actual transformation of in vitro cultures of normal mammalian cells into tumor cells by brief exposure of these cell cultures to small amounts of carcinogenic agents. When the transformed cells are implanted into an animal of the species and strain from which the original normal cells were harvested they develop into malignant tumors. The basis for the mutagenicity test is the hypothesis that carcinogenesis, like mutagenesis, is due to

damage of the hereditary material of the cell, DNA. The Ames test, which uses certain mutants of the bacterium *Salmonella typhimurium* is a well-known example of one of the mutagenicity tests designed to show carcinogenic potential (Bartsch, 1976; Fishbein, 1977; McCann, et al., 1975).

It is essential that the procedures used to determine a chemical's carcinogenicity potential be established on the best scientific basis as practically possible. For the purpose of the Michigan Air Priority Chemicals List, chemicals are classified as human positive, potential human, and animal positive carcinogens according to data and interpretation as reported by the IARC, NCI, or NIOSH (IARC; Sontag, et al., 1976; Tomatis, 1976; USHEW). Chemicals are placed in the other carcinogenicity categories according to the best information available in the scientific literature. Chemicals can be reclassified to appropriate categories as additional data become available.

For the purpose of the Michigan Air Priority Chemicals List, the categories of carcinogenic effects are defined as follows:

- I. Human positive carcinogens are chemicals which have been demonstrated by epidemiological and/or clinical studies to cause cancer in man.

- II. Potential human carcinogens are chemicals which are animal positive carcinogens and have been suggested to cause cancer in man but adequate epidemiological and/or clinical data are not available at the present time to unequivocally substantiate their carcinogenic effect in man.
- III. Animal positive carcinogens are chemicals which have been demonstrated to cause cancer in at least one animal species in replicate studies or demonstrated to cause cancer in more than one animal species.
- IV. Potential animal carcinogens are chemicals which have been tested in a nonreplicated study and shown to cause cancer in one animal species.
- V. Strongly suspect carcinogens are chemicals which fit one of the following descriptions:
1. The chemical has been shown, using mutagenicity or cell transformation tests (with or without enzyme activation) designed to demonstrate carcinogenic potential, to be mutagenic in three groups of organisms (or cell cultures from three groups) not to include more than:

- a. one lower test organism (i.e. bacteria, yeast, fungi)
- b. one plant test organism (including algae)
- c. two species of mammalian test organisms
- d. one insect test organism
- e. one macroscopic aquatic or semi-aquatic organism.

2. The chemical has been shown to transform normal human cells (e.g. diploid fibroblasts) into tumor cells in replicated tests designed to demonstrate carcinogenic potential.

VI. Suspect carcinogens are chemicals which fit one of the following descriptions:

1. The chemical has been shown using mutagenicity or cell transformation tests (with or without enzyme activation) designed to demonstrate carcinogenic potential, to be mutagenic in any one organism (or cell culture from any organism).
2. The chemical has been shown to transform normal human cells (e.g. diploid fibroblasts) into tumor cells in unreplicated tests.

REFERENCES

- Bartsch, H. 1976. Predictive value of mutagenicity tests in chemical carcinogenesis. Mutation Research, 38:117-190.
- Fishbein, L. 1977. Potential Industrial Carcinogens and Mutagens. Prepared for the Office of Toxic Substances, Environmental Protection Agency, Washington, DC. EPA 560/5-77-005.
- International Agency for Research on Cancer. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man. Lyon, France.
- McCann, J., Chico, E., Yamasaki, E., and Ames, B. N. 1975. Detection of carcinogens and mutagens in the Salmonella/microsome test: Assay of 300 chemicals. Proc. Natl. Acad. Sci., 72:5135-5139.
- Sontag, J. M., Norbert, P. O., Saffrotti, U. 1976. Guidelines for carcinogen bioassay in small rodents. National Cancer Institute Carcinogenesis Technical Report Series, No. 1. U.S. Department of Health, Education, and Welfare Publication No. (NIH)76-801.

Tomatis, L. 1976. The IARC program on the evaluation of carcinogenic risk of chemicals to man. Ann. N.Y. Acad. Sci., 271:396-409.

U.S. Department of Health, Education and Welfare. Bioassay of chemical substances for possible carcinogenicity. National Cancer Institute, Carcinogenesis Technical Report Series.

HEREDITARY MUTAGEN

CRITERION:

<u>SCORE</u>	<u>CATEGORY</u>
7	Confirmed hereditary mutagen
4	Potential hereditary mutagen in multicellular organisms
2	Potential hereditary mutagen in micro-organisms
0	Not demonstrated to be a hereditary mutagen
*	Insufficient information

RATIONALE:

On a theoretical basis, mutagens can produce significant effects on the long-term survival of any species. In spite of this significant potential impact, effects due to mutagenic substances in nature might not be discernible for a long time (deSerres and Sheridan, 1973).

Most tests for mutagenicity have been designed to maximize their predictive value for carcinogenicity. The present criterion has been selected to emphasize mutagenic effects. Such mutagens represent a high level of environmental and human health concern and should therefore be included in the Michigan Air Priority Chemicals List (Canadian Ministry of Health and Welfare, 1975).

For the purpose of the Michigan Air Priority Chemicals List, the classification of Hereditary Mutagens to specific categories is defined below:

To be a confirmed hereditary mutagen, a chemical must produce a statistically significant dose related mutagenic effect in test microorganisms without the use of metabolic activators (i.e. rodent liver fractions, etc.) and in a complex multicellular animal (i.e. insect, rodent, etc.) with mutations inheritable in subsequent generations of the test organisms.

To be a potential hereditary mutagen in a multicellular organism, a chemical must produce a statistically significant dose related mutation in a complex multicellular organism (i.e. plants, insects, rodents, etc.) with mutations inheritable in subsequent generations of the test organism.

To be a potential hereditary mutagen in microorganisms a chemical must produce a statistically significant dose related mutation in exposed test microorganisms with mutations inheritable in subsequent generations.

A chemical is not considered to be a hereditary mutagen if it has been adequately tested in several appropriate animal species with negative findings.

REFERENCES

Canadian Ministry of Health and Welfare. 1975. The Testing of Chemicals for Carcinogenicity, Mutagenicity, and Teratogenicity. Ottawa.

deSerres, F. J., Sheridan, W. (eds.) 1973. The evaluation of
chemical mutagenicity data in relation to population risk.
Environmental Health Perspectives, Issue 6.

TERATOGENICITY

CRITERION:

<u>SCORE</u>	<u>CATEGORY</u>
7	Confirmed teratogen
3	Potential teratogen
0	Not teratogenic
*	Insufficient information

RATIONALE:

Since terrestrial and aquatic populations are exposed to a wide variety of chemicals in the environment on a continuing or chronic basis, recognition and control of teratogens is necessary to prevent repetition of incidences such as Minimata disease and the "thalidomide disaster". A teratogen is any chemical which causes alterations in the formation of cells, tissues, and organs resulting from physiologic and biochemical changes, i.e. generative changes. Teratogenic change occurs during embryogenesis and may affect the function as well as the structure of developing cells, tissues, and organs (Becker, 1975; Canadian Ministry of Health and Welfare, 1975).

A chemical is classified as a confirmed teratogen if it has been shown by epidemiological evidence to be teratogenic in humans, demonstrated to be teratogenic in two animal species by the oral, dermal or inhalation route of exposure (USEPA, 1978) or demonstrated in one animal species in replicate studies to be teratogenic by the oral, dermal or inhalation route of exposure.

To be categorized as a potential teratogen the chemical must be teratogenic in one animal species by oral, dermal or inhalation route in an unreplicated study.

A chemical is not considered to be teratogenic if it has been adequately tested in several appropriate animal species with negative findings (USEPA, 1978).

A confirmed teratogen would be placed on the Air Priority Chemicals List automatically. The ranking system for suspect teratogens is more lenient to allow for lack of information and consideration of other concerns about the chemical. Should conflicting studies be found, review of the research procedures will be made to evaluate the adequacy of the study and validity of the results.

REFERENCES:

Becker, B. A. 1975. Teratogens. In: Toxicity - The Basic Science of Poisons. Edited by L. J. Casarett and J. Doull. MacMillan Publishing Company, Inc. New York, pp 768.

Canadian Ministry of Health and Welfare. 1975. The Testing of Chemicals for Carcinogenicity, Mutagenicity, and Teratogenicity. Ottawa.

deSerres, F. J., Sheridan, W. (eds.). 1975. The evaluation of chemical mutagenicity data in relation to population risk. Environmental Health Perspectives, Issue 6.

PERSISTENCE

CRITERION:

<u>SCORE</u>	<u>CATEGORY</u>	<u>t 1/2 in weeks (Soil, water or air)</u>
4	Very persistent	> 52
3	Persistent	40 - 52
2	Slowly degradable	27 - 39
1	Moderately degradable	14 - 26
0	Readily degradable	0 - 13
*	Insufficient information	

RATIONALE:

A major factor for assessing the potential hazard of an environmental contaminant is consideration of its environmental persistence. Many synthetic compounds are highly resistant to natural degradation processes (i.e. biodegradation, photochemical degradation, chemical degradation) and may persist and accumulate in the environment. Continuous exposures to some substances, even at low concentrations, may result in chronic toxic effects on organisms and cumulative effects on populations. In addition, the longer a substance persists, the greater the opportunity for it to bioaccumulate to toxic levels in organisms. Of equal importance, persistent substances also have the potential for wider dispersal in the environment.

Several techniques for studying persistence and degradation of chemical substances in the environment are reported in the

literature (Draggan and Giddings, 1978; Howard, et al., 1975; U.S. EPA, 1979; U.S. EPA, 1978; U.S. EPA, 1975; Witherspoon, et al., 1976). The design of experimental procedures for environmental persistence testing is often made on an individual chemical basis and is extremely variable. In contrast to many toxicity testing methods, techniques for studying the fate of chemicals in the environment are not standardized and interpretation of test results frequently varies. This makes it difficult to compare persistence data between chemicals.

Due to the lack of standardization among test protocols, only data obtained from test systems designed to closely simulate the natural soil, water or air environment are used for the persistence hazard assessment. Test systems are evaluated by DNR staff and the Michigan Critical Materials Advisory Committee. Data in the form of the half-life ($t_{1/2}$) of the chemicals in soil or water are used in order to allow for comparison between chemicals.

Time ranges for each category of persistence were selected based on data for pesticides. The very persistent category ($t_{1/2} > 52$ weeks) includes many of the chlorinated hydrocarbon insecticides (e.g. DDT, aldrin, lindane) while the readily degradable category ($t_{1/2} = 0-13$ weeks) includes many of the organophosphorus insecticides (e.g. dichlorvos, disulfoton, malathion) (Brown, 1978). It must be emphasized that the environmental persistence criterion was developed on information currently available. The criterion will be modified as new information and testing methodologies become available.

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BIOACCUMULATION

CRITERION:

<u>CATEGORY</u>		
<u>SCORE</u>	<u>BIOACCUMULATION</u>	<u>LOG P</u>
7	≥ 4000	≥ 6.00
3	1000 - 3999	5.00 - 5.99
2	700 - 999	4.50 - 4.99
1	300 - 699	4.00 - 4.49
0	< 300	< 4.00
*	Insufficient information	

RATIONALE:

Partition coefficients for n-octanol/water are often used as a reliable measure of the tendency for an organic compound to transfer from water to organisms (lipid phase) and bioaccumulate. The n-octanol/water partition coefficient, P, is defined as the ratio of the concentration of a compound in octanol to its concentration in water. It is generally expressed as the log (base 10) of the partition coefficient, log P. The partition coefficient has proven useful as a means of predicting soil adsorption (Briggs, 1973), biological uptake (Kenaga, 1972; Hamelink, et al., 1977), lipophilic storage (Davies, et al., 1975), and biomagnification (Lu, et al., 1975; Metcalf, et al., 1973; Metcalf, et al., 1975; Neely, et al., 1974). These studies have shown a direct relationship between log P values and log bioconcentration factors for organic compounds.

Highly bioaccumulative compounds have log P values greater than 5.0. Examples of these include DDT; DDE; 2,4,5,2',5'-PCB; 2,4,5,2',4',5'-PCB; and leptophos with log P values of 6.19, 5.69, 6.11, 6.72, and 6.31, respectively (Chiou, et al., 1977). Compounds which bioaccumulate to a lesser degree, such as monochlorobenzene, tetrachloroethylene, dicapthon, and diphenyl ether have log P values of 2.18, 2.60, 3.58, and 4.20 respectively (Chiou, et al., 1977; Ware, et al., 1977).

Log P values greater than 6.0 must be interpreted carefully before being utilized as a bioaccumulation indicator. An increase in the log P value correlates with increased propensity for bioaccumulation for many classes of chemicals. However, for certain groups of chemicals, large log P values (i.e. greater than 6.0) do not correlate to an increased tendency to bioaccumulate (Tulp and Hutzinger, 1978). For example, apolar polymers (such as plastics) have computed log P values that are very large, yet they are not bioaccumulated. Squalene, an isoprenoid hydrocarbon, is excreted quantitatively in the feces of rats after an oral dosage. The compound is not absorbed from the intestine, yet its computed log P value is 15.5. Additionally, some chemicals having large log P values are readily metabolized and not bioaccumulated. An organic chemical that has a log P greater than or equal to 6.0 must have the potential to bioaccumulate before it receives a score of seven points.

An organic chemical that has a log P greater than or equal to 6.0, which has the potential to bioaccumulate, and for which no data on bioaccumulation in fish is available; or a chemical that bioaccumulates greater than or equal to 4,000 times in fish (wet weight basis) at equilibrium will receive a score of seven points for the bioaccumulation category.

A chemical that has a log P less than 6.0, which has the potential to bioaccumulate and for which no data on bioaccumulation in fish is available; or a chemical that bioaccumulates less than 4,000 times in fish (wet weight basis) at equilibrium will be scored as listed above.

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OTHER ADVERSE EFFECTS

The Other Adverse Effects factor is divided into three subfactors for the purpose of evaluating the available data and assigning points. Each subfactor is assigned an individual score. The score assigned to the Other Adverse Effects factor is the combined scores of the three individual subfactors. Other Adverse Effects on terrestrial animals and aquatic organisms are considered in a single subfactor to be consistent with the acute toxicity criterion. The score assigned to this subfactor is the highest score given to any individual category. For example, a chemical substance which causes irreversible effects to mammals at a very low dose and has an aquatic median effective concentration of 1 mg/l is assigned a score of seven based on the toxicity to mammals.

A. TERRESTRIAL ANIMALS AND AQUATIC ORGANISMS

1. TERRESTRIAL ANIMALS

CRITERION:

<u>SCORE</u>	<u>CATEGORY</u>
7	Produces an irreversible effect at a very low dose (i.e. <0.5 mg/kg, <50 ug/l) by oral, dermal or inhalation routes
3	Irreversible effects during or following cessation of low level exposure by oral, dermal or inhalation routes
2	Reversible effects following cessation of low level exposure by oral, dermal or inhalation routes
0	No detectable adverse effects
*	Insufficient information

RATIONALE:

Environmental dispersion and dilution of deleterious chemicals may present adverse biological impacts at concentrations other than those necessary to cause death of 50% of observed populations. Prolonged exposure or sublethal adverse effects must be addressed since these doses present the predominant environmental contamination circumstances. These lower dosage levels may produce reversible or irreversible effects. Reversible and irreversible effects in most cases are dose dependent. Lower level doses may produce reversible effects, whereas higher doses of the same chemical may cause irreversible effects (McRae, et al., 1978). Except for the extremely low dose category receiving 7 points, exact numerical exposure cut-off points have not been included in order to allow flexibility in evaluating what concentrations could realistically occur in the environment and judgement of the applicability and validity of the data reviewed. For the sake of the Michigan Air Priority Chemicals Program the following definitions apply.

Irreversible Adverse Effects (Casarett and Doull, 1975; Robbins and Angell, 1971): Continued or intermittent, oral, dermal (including ocular) or inhalation exposure that results in irreversible impairment of anatomical, physiological, biochemical, or behavioral functions during exposure or following cessation of exposure. Examples would include but not be limited to:

Benign neoplasias

Induced autoimmunity

Embryo or fetal mortality

Hypersensitivity

Metabolic disorders (i.e. hyper/hypoglycemia, hypo/
hyperthyroidism)

Cellular necrosis causing permanent reduction of normal
system, organ, or tissue structure and/or function
resulting in such disorders or damage as:

cataracts	aplastic anemia
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glaucoma	retinal degeneration
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glomerulonephritis	renal failure
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hepatic failure	cirrhosis
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arteriosclerosis	neuronal degeneration (demyelination)
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sterility from testicular or ovarian atrophy, such as
germinal aplasia leading to aspermia or azoospermia

NOTE: Carcinogenic, mutagenic, and teratogenic effects are
excluded from this criterion since they have been addressed
in their individual criteria.

Reversible Adverse Effects (Casarett and Doull, 1975; Robbins and
Angell, 1971): Continued or intermittent, oral, dermal
(including ocular) or inhalation exposure that results in
reversible impairment of functional capacity, however, enhances
the susceptibility of organisms to other deleterious
environmental effects. Examples would include but not be limited
to:

Cellular lipid, carbohydrate, or protein infiltration not resulting in cell death;

Enzyme or hormone inhibition, (i.e. antiestrogenic properties, acetylcholinesterase inhibition);

Inflammation, and cellular necrosis followed by normal structure and/or function regeneration such as possible from:

hemolytic anemia	retinal hemorrhage
bone marrow suppression	renal tubular necrosis
vitamin deficiencies	agranulocytosis
thrombocytopenia	cerebral edema
methemoglobinemia	narcosis
skin or eye irritation (erythema and/or edema)	peripheral neuropathy

Besides dosage level, evaluation of environmental toxicity data must address two additional considerations: routes and duration of exposure. The most common exposure to terrestrial environmental contaminants by the water route would be skin or eye contact and ingestion. Sublethal skin and eye contact may elicit irritation, contact sensitization, ulceration, photosensitivity, pigmentary changes, nodules, vesicles, tumors, and a potential for absorption leading to systemic toxicity (NAS, 1975).

Skin and eye damage assessments can be made with available testing methods. There are currently five types of primary skin irritation tests available. Two tests are of Haskell Laboratory design and the other three tests are procedures from federal regulations: the Federal Hazardous Substances Act and the Department of Transportation Class B poison and skin corrosion tests. The tests are designed to indicate localized potential and range from minor erythema through edema to corrosive damage indicated by necrosis. Two common eye tests are available: The Haskell Eye Irritation Test and the Federal Hazardous Substances Act eye irritation tests.

Duration of exposure is the other major consideration in reviewing adverse effects data. Acute studies which signify a single exposure recorded as death or no death, have been addressed in the acute toxicity section. Other exposures may be classified as prolonged or chronic. For this assessment model, prolonged studies consist of repeated exposures to a substance which may last up to 90 days. These studies, often referred to as subacute, generally use a fraction of the dose found to produce lethality in an acute study. A prolonged study is designed to show cumulative toxic effects from relatively low level exposures. Such exposures may simulate environmental contact to toxicants from accidental spills of hazardous substances, pesticide applications, air pollution incidents, occupational exposures, or other types or incidents where effects may be graded as changes in biological parameters rather than in all or none response observed in acute studies.

2. AQUATIC ORGANISMS

CRITERION:

<u>SCORE</u>	<u>MEDIAN EFFECTIVE CONCENTRATION (EC-50)</u>
7	< 0.1 mg/l
3	0.1 - 1 mg/l
2	> 1 - 10 mg/l
1	> 10 - 100 mg/l
0	> 100 mg/l
*	Insufficient information

RATIONALE:

In addition to basic acute toxicity tests [i.e. 48-hr (invertebrates), 96-hr (fish)], toxicity studies measuring effects of chemical exposure on the reproductive process and other sublethal effects (i.e. chronic tests) are essential to a comprehensive hazard assessment program. There are basically two types of chronic toxicity tests, partial and full. A partial chronic toxicity test is one which includes a critical portion of a test organism's life cycle while a full chronic test will minimally include one complete life cycle. Full life cycle and partial life cycle tests with fish and invertebrates have become quite common and typically provide lethality and growth results as well as effects on reproduction (e.g. spawning, gametogenesis and hatching success) and other sublethal responses during the course of testing (Brungs and Mount, 1978). A description of seven standard chronic toxicity test follows:

- a. Fish Full Life Cycle Test (U.S. EPA, 1972a).

This test allows exposure from newly hatched fry through reproduction and exposure of the next generation. It provides exposure during sensitive developmental stages and assesses the growth and the reproductive processes. A common standard test organism is the fathead minnow (*Pimephales promelas*) and the test takes approximately nine months to complete.

- b. Fish Critical Life Stage Exposure Test (Macek and Sleight, 1977; McKim, 1977).

This test allows exposure during a very sensitive stage of the life cycle. The test starts with exposure of the organisms during most, preferably all, of the embryonic period and exposure of fry for a period of 30 days after hatching for warm water fish with embryogenic periods ranging from 1 to 14 days, and for 60 days after hatching for fishes with longer embryogenic periods (e.g. salmonids). Eggs from the standard test organisms, commonly fathead minnows (*P. promelas*), rainbow trout (*Salmo gairdneri*), or bluegill (*Lepomis macrochirus*), are utilized in this test. Each test requires approximately five to ten weeks for completion.

- c. Partial Life Cycle (U.S. EPA, 1972b).

This test generally parallels the Fish Critical Life Stage Exposure Test described earlier, but makes appropriate modifications in exposure conditions because of the species

and also starts with juvenile fish. The most common test organism for these studies is the brook trout (*Salvelinus fontinalis*).

- d. Daphnia Chronic (Biesinger and Christensen, 1972; Biesinger, 1974; Adema, 1978; Canton and Adema, 1978).

This test is a full life cycle reproductive test which utilizes the freshwater invertebrates, *Daphnia magna* and *D. pulex*. The test requires only three weeks to complete.

- e. Midge Chronic (Cairns, et al., 1978).

This full life cycle reproductive test utilizes a variety of species of these widely distributed genera (e.g. *Chironomus*). Benthic organisms are easy to culture and use in an extensive program for evaluating compounds of limited solubility or those that tend to accumulate in sediments.

- f. Algal Toxicity Tests (U.S. EPA, 1974, U.S. EPA, 1971).

A variety of tests have been developed which utilize algae as test organisms. Although algal tests are sufficiently short that they can be considered acute tests, most are in part multigeneration reproductive tests. No single published procedure for algal toxicity testing has gained wide acceptance, but recent candidates are usually patterned after the EPA Algal Assay Procedure (Bottle Test) developed to test for algal growth potential and limiting nutrient effects.

g. Lemna Inhibition (U.S. EPA, 1978).

The duckweed, *Lemna minor*, has been used as a test organism for assessing the effects of chemical substances on aquatic macrophytes.

Aquatic chronic toxicity data from these tests will be scored based on the median effective concentration. For the purpose of the Michigan Air Priority Chemicals List the median effective concentration (EC-50) is defined as the concentration of a test material that causes 50 percent reduction of survival, growth, or reproduction of a test population, when statistically compared to a control population, within a chronic test period.

B.	PLANT		
	CRITERION:		
	<u>SCORE</u>	<u>WATER</u>	<u>GAS/VAPOR (ppm)</u>
	3	< 0.5 mg/l	< 1
	2	0.5 - 5 mg/l	1 - 10
	1	> 5 - 50 mg/l	> 10 - 100
	0	> 50 mg/l	> 100
	*	Insufficient information	

RATIONALE:

Concern for plant toxicity is partially due to the adverse impact of water contaminants. Contaminated irrigation waters may have significant deleterious effects on both commercial and domestic plant growth. While it appears no standard testing procedures for terrestrial phytotoxicity have been published, data, and testing methodologies are available in the literature (McKee and Wolf, 1963).

Battelle Pacific Northwest Laboratories describe a level of plant damage by use of a "mean inhibitory limit" or ILM. This is defined as the concentration at which 50% of the biomass, cell count, or photosynthetic activity is reduced as compared with a control over a 14 day period. For the sake of this assessment process, the Battelle definition will apply. A material is categorized as phytotoxic to terrestrial plants if the "mean inhibitory limit" is ≤ 50 mg/l for irrigation waters (Battelle, 1973) and ≤ 100 ppm as a gas/vapor in air.

For terrestrial plants, photosynthetic activity measurements are based on carbon dioxide exchange between the plant and its environment. The absolute CO₂ exchanges are calculated by the difference in CO₂ concentration in incoming and outgoing air. The air exchange rate is given as the amount of CO₂ per square area of leaf multiplied by the unit of time measured (Mudd and Kozlowski, 1975).

Guderian (1977) describes several additional methods of damage evaluation:

1. Changes in growth, yield, and plant quality
2. Effects on seed quality and reproduction
3. Degree of foliar injury.

The degree of foliar injury is measured by percent of necrotic area. Injury is scaled from very slight necrosis or chlorosis to extreme damage noted as very severe necrosis or chlorosis.

Due to the variability of methodologies and lack of standard testing methods, phytotoxicity data will be reviewed for completeness, testing approach and damage as evaluated by the researcher.

C. AESTHETICS

CRITERION:

Estimated threshold level in water (mg/l) producing tainting of fish and/or taste and odor	Foaming Properties and/or produces floating film and/or imparts major color change in water	Produced an objectionable odor in air (ppm).
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SCORE

1	≤ 0.001	Yes	≤ 0.0001
0	> 0.001	No	> 0.0001

RATIONALE:

Wastewater treatment plant discharges and industrial process waste effluent may contain organic compounds which can impart objectionable taste, odor, or color to fish and other aquatic organisms. Usually, these offending materials can cause tainting at levels lower than those recognized as causing toxic effects (U.S. EPA, 1973).

The levels indicated in the criterion represent the extreme end of the level of detectability. Compounds such as chlorophenols, which taint fish at very low concentrations or impart an undesirable taste to drinking water would be included (Lillard and Poers, 1975). Objectionable properties are difficult to quantify since these adverse conditions are subjectively determined. Scoring is therefore low to give greater weight to adverse biological effects according to the philosophy of this list.

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TABLE 3: CHEMICAL ASSESSMENT PROCESS - MICHIGAN DEPARTMENT OF NATURAL RESOURCES

THE HAZARD ASSESSMENT PROCESS IS A PRIORITY RANKING - POINT ASSIGNMENT SYSTEM USED TO EVALUATE CHEMICALS FOR POSSIBLE INCLUSION ON THE CRITICAL MATERIALS REGISTER OF THE AIR PRIORITY CHEMICALS LIST. FACTORS OF ENVIRONMENTAL CONCERN FOR POTENTIALLY DELETERIOUS SUBSTANCES ARE SEPARATED INTO SEVEN SPECIFIC AREAS: 1) ACUTE TOXICITY; 2) CARCINOGENICITY; 3) HEREDITARY MUTAGENICITY; 4) TERATOGENICITY; 5) OTHER ADVERSE EFFECTS (INCLUDING SUBACUTE AND CHRONIC EFFECTS TO TERRESTRIAL AND AQUATIC LIFE, PHYTOTOXICITY AND AESTHETICS; 6) PERSISTENCE; 7) BIOACCUMULATION. THE HAZARD ASSESSMENT PROCESS IS BASED ON EXTENSIVE REVIEW OF THE SCIENTIFIC LITERATURE ON PHYSICAL, CHEMICAL, AND TOXICOLOGICAL PROPERTIES OF INDUSTRIAL AND AGRICULTURAL CHEMICALS. CHEMICALS ARE NUMERICALLY SCORED AS TO THEIR HAZARDS. THOSE CHEMICALS WHICH HAVE A TOTAL SCORE OF SEVEN POINTS OR HIGHER IN THE AIR (A) CATEGORY ARE PLACED ON THE AIR PRIORITY CHEMICALS LIST. THOSE CHEMICALS WHICH HAVE A TOTAL SCORE OF SEVEN POINTS OR HIGHER IN THE WATER (W) CATEGORY ARE PLACED ON THE CRITICAL MATERIALS REGISTER.

A COMPLETE EXPLANATION OF THE CRITICAL MATERIALS REGISTER AND THE HAZARD ASSESSMENT PROGRAM CAN BE FOUND IN THE PUBLICATION, 'CRITICAL MATERIALS REGISTER 1980'. A COMPLETE EXPLANATION OF THE AIR PRIORITIES LIST CAN BE OBTAINED FROM THE OFFICE OF TOXIC MATERIALS CONTROL. FOR MORE INFORMATION ON THESE PROGRAMS

WRITE:

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL SERVICES DIVISION
P.O. BOX 30028
LANSING, MICHIGAN 48909

CALL:

MDNR OFFICE OF TOXIC MATERIALS CONTROL
(517) 373-2190

KEY:

TOTAL SCORES	CARCN=CARCINOGENICITY	PER=PERSISTENCE
A=AIR SCORE	O=ORAL ROUTE	S=SOIL
W=WATER SCORE	D=DERMAL ROUTE	W=WATER
ACUTE TOXICITY	I=INHALATION ROUTE	A=AIR
TOT=TOTAL ACUTE TOXICITY	M=MULTIPLE ROUTES	T=SOIL AND WATER
ORA=ACUTE ORAL TOXICITY	R=OTHER ROUTE	Q=SOIL, WATER AND AIR
DER=ACUTE DERMAL TOXICITY	HP=HUMAN POSITIVE	N-A=NOT APPLICABLE
AQU=ACUTE AQUATIC TOXICITY	PH=POTENTIAL HUMAN	BIO=BIOACCUMULATION
INH=ACUTE INHALATION TOXICITY	AP=ANIMAL POSITIVE	B=BIOACCUMULATION FACTOR
OTHER ADVERSE EFFECTS	PA=POTENTIAL ANIMAL	P=LOG PARTITION COEFFICIENT
ATE=ADVERSE TERRESTRIAL EFFECTS	SS=STRONGLY SUSPECT CARCINOGEN	
O=ORAL ROUTE	SC=SUSPECT CARCINOGEN	
D=DERMAL ROUTE	NC=NOT CARCINOGENIC	
I=INHALATION ROUTE	HMUT=HEREDITARY MUTAGENICITY	ALL CATEGORIES:
M=MULTIPLE ROUTES	TERT=TERATOGENICITY	*=INSUFFICIENT INFORMATION
R=OTHER ROUTE	O=ORAL ROUTE	NS=NO SCORE
AQE=ADVERSE AQUATIC EFFECTS	D=DERMAL ROUTE	
APE=ADVERSE PLANT EFFECTS	I=INHALATION ROUTE	
AAE=ADVERSE AESTHETIC EFFECTS	M=MULTIPLE ROUTES	
	R=OTHER ROUTE	

*******ATTENTION*******

SOME OF THE DATA HAVE BEEN ABBREVIATED ACCORDING TO PROCEDURES GENERALLY ACCEPTED BY THE SCIENTIFIC COMMUNITY. DUE TO THE COMPLEX AND HIGHLY TECHNICAL NATURE OF MUCH OF THE INFORMATION, CAREFUL INTERPRETATION OF THE DATA IS ESSENTIAL BEFORE AN ACCURATE HAZARD ASSESSMENT CAN BE MADE. INTERPRETATION OF THE INFORMATION BY INDIVIDUALS NOT EXPERIENCED WITH THIS SUBJECT COULD RESULT IN ERRONEOUS JUDGEMENTS OF THE HAZARDS ASSOCIATED WITH THESE CHEMICAL SUBSTANCES. ALL QUESTIONS ON DATA ACCURACY AND INTERPRETATION SHOULD BE DIRECTED TO THE OFFICE OF TOXIC MATERIALS CONTROL (517) 373-2190.

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP I

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H ₂ MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
MONO AROMATIC HYDROCARBONS																		
benzene	W-11-6*	2	1	*	2	NS	7-PH	*	*	02-2*	2	*	*	*	*--	*---	00071432	0679
	A-11-6*	2	1	*	2	1	7-PH	*	*	02-2*	2	*	*	*	*--	*--		0679
ethyl benzene																	00100414	
styrene	W-07-5*	2	2	*	2	NS	3-PA	*	*	02-1*	2	*	*	0	*---	*---	00100425	0579
	A-07-5*	2	2	*	2	*	3-PA	*	*	02-1*	2	*	*	0	*--	*--		0579
toluene																	00108883	
xylene	W-07-4*	2	1	*	2	NS	*---	*	3	02-2*	2	*	*	0	*--	0-P-	01330207	0680
	A-07-4*	2	1	*	2	1	*---	*	3	02-2*	2	*	*	0	*--	0-P		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP 11

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP III

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
POLYCYCLIC AROMATIC																		
HYDROCARBONS (PAH)																		
PAH's																		
acenaphthylene																	00208968	
anthracene																	00120127	
benz(a)anthracene	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*---	*---	00056553	0579
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*---	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP III

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
benz(a)anthracene, 7-12- dimethyl																	00057976	
benzo(b)fluoranthene	W-03-8*	*	*	*	*	NS	3-PA	*	*	NS-3*	*	*	*	*	*--	*--	00205992	0680
	A-03-8*	*	*	*	*	*	3-PA	*	*	NS-3*	*	*	*	*	*--	*--		0680
benzo(j)fluoranthene																	00205823	
benzo(k)fluoranthene																	00207089	
benzo(ghi)perylene																	00151242	
benzo(a)pyrene	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00050328	0679
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0679
benzo(e)pyrene																	00192972	
chrysene																	002118019	

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP III

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
dibenz(a,h)anthracene	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00053703	0579
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0579
dibenzo(def,mno)chrysene																	00191264	
dibenzo(b,def)chrysene	W-02-8*	*	*	*	*	NS	2-SS	*	*	NS-3*	*	*	*	*	*--	*--	00189640	0680
	A-02-8*	*	*	*	*	*	2-SS	*	*	NS-3*	*	*	*	*	*--	*--		0680
dibenzo(a,i)pyrene	A-02-8*	*	*	*	*	*	2-SS	*	*	NS-3*	*	*	*	*	*--	*--	00189559	0680
	W-02-8*	*	*	*	*	NS	2-SS	*	*	NS-3*	*	*	*	*	*--	*--		0680
phenanthrene																	00085018	
pyrene																	00129000	
Indeno(1,2,3-cd)pyrene	W-02-8*	*	*	*	*	NS	2-SS	*	*	NS-3*	*	*	*	*	*--	*--	00193395	0680
	A-02-8*	*	*	*	*	*	2-SS	*	*	NS-3*	*	*	*	*	*--	*--		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP IV

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
HALOGENATED MONOAROMATICS																		
chlorinated styrenes																	G	
chlorinated benzenes																	G	
1,3-dichlorobenzene																	00541731	
hexachlorobenzene	W-29-2*	1	1	*	*	NS	7-AP	*	7	03-1*	3	*	*	0	4-S	7-P	00118741	0579
	A-29-2*	1	1	*	*	*	7-AP	*	7	03-1*	3	*	*	0	4-S	7-P		0579
1,2,4-trichlorobenzene																	00120821	
3-(chloromethyl)pyridine	W-09-7*	2	2	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	---	---	06959484	0680
hydrochloride	A-09-7*	2	2	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	---	---		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP V

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
HALOGENATED DIAROMATIC																		
HYDROCARBONS																		
chlorinated naphthalenes																	G	
polychlorinated biphenyls	W-31-3*	7	1	1	7	NS	7-AP	*	3	03-2*	3	*	*	*	4-Q	7-B	G	0579
(PCBs)	A-31-3*	7	1	1	7	*	7-AP	*	3	03-2*	3	*	*	*	4-Q	7-B		0579
polybrominated biphenyls	W-17-4*	0	0	0	*	NS	*---	*	3	03-2*	3	*	*	*	4-S	7-B	G	0579
(PBBs)	A-17-4*	0	0	0	*	*	*---	*	3	03-2*	3	*	*	*	4-S	7-B		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP VI

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H ₂ MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
HALOGENATED PHENOLS																		
chlorinated cresols																	G	
chlorinated phenols																	G	
pentachlorophenol	W-24-4*	7	3	2	7	NS	*---	*	3	07-2*	*	7	*	*	0-S	7-B	00087865	0679
	A-24-4*	7	3	2	7	*	*---	*	3	07-2*	3	7	*	*	0-S	7-B		0679
trichlorophenols	W-12-5*	1	1	*	*	NS	7-AP	*	*	03-1*	3	3	*	0	*--	*--	G	0579
	A-12-5*	1	1	*	*	*	7-AP	*	*	03-1*	3	3	*	0	*--	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP VII

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP VIII

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP IX

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H ₂ MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
PHTHALATE ESTERS																		
phthalate esters																	G	
benzylbutyl phthalate																	00085687	
diethyl phthalate																	00084662	
di-n-butyl phthalate	W-09-6*	7	*	*	7	NS	*---	*	*	02-2*	2	*	*	*	*--	0-P	00084742	0679
	A-09-6*	7	*	*	7	*	*---	*	*	02-2*	2	*	*	*	*--	0-P		0679
di-isobutyl phthalate																	00084695	
dimethyl phthalate																	00131113	
di-n-octyl phthalate	W-09-7*	*	*	*	*	NS	*---	*	*	02-2*	2	*	*	*	*--	7-B	00117840	0579
	A-09-7*	*	*	*	*	*	*---	*	*	02-2*	2	*	*	*	*--	7-B		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP IX

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP X

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
AROMATIC AMINES																		
aromatic amines																	G	
2-aminoanthraquinone	W-10-7*	*	*	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00117793	0680
	A-10-7*	*	*	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0680
aminoazobenzene	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00060093	0679
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0679
o-aminoazotoluene	W-10-7*	*	*	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00097563	0680
	A-10-7*	*	*	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0680
4-aminobiphenyl	W-09-7*	2	2	*	*	NS	7-HP	*	*	NS-3*	*	*	*	*	*--	*--	00092671	0679
	A-09-7*	2	2	*	*	*	7-HP	*	*	NS-3*	*	*	*	*	*--	*--		0679
3-amino-9-ethylcarbazole	W-09-7*	2	2	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00132321	0680
	A-09-7*	2	2	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
1-amino-2-methyl	W-10-7*	*	*	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00082280	0680
anthraquinone	A-10-7*	*	*	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP X

CHEMICAL NAME	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
aminotriazole (amitrole)	W-11-5*	2	1	*	2	NS	7-AP	*	*	02-2*	2	*	*	*	0-S	*--	00061825	0679
	A-11-5*	2	1	*	2	*	7-AP	*	*	02-2*	2	*	*	*	0-S	*--		0679
aniline	A-07-5*	2	2	1	2	*	3-PA	*	*	02-1*	2	*	*	0	*--	*--	00062533	0679
	W-07-5*	2	2	1	2	NS	3-PA	*	*	02-1*	2	*	*	0	*--	*--		0679
o-anisidine	W-08-7*	1	1	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00090040	0579
	A-08-7*	1	1	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0579
o-anisidine hydrochloride	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00134292	0680
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
5-nitro-o-anisidine	W-08-7*	1	1	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00099592	0680
	A-08-7*	1	1	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
o-toluidine	W-07-5*	2	2	1	*	NS	3-PA	*	*	02-2*	2	*	*	*	*--	0-P	00095534	0680
	A-07-5*	2	2	1	*	*	3-PA	*	*	02-2*	2	*	*	*	*--	0-P		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP X

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
o-toluidine hydrochloride	W-10-6*	1	1	*	*	NS	7-AP	*	*	02-2*	2	*	*	*	---	---	00636215	0680
	A-10-6*	1	1	*	*	*	7-AP	*	*	02-2*	2	*	*	*	---	---		0680
2,4,5-trimethylaniline	W-08-7*	1	1	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	---	---	00137177	0680
	A-08-7*	1	1	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	---	---		0680
p-cresidine	W-08-7*	1	1	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	---	---	00120718	0680
	A-08-7*	1	1	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	---	---		0680
2,4-diaminoaniline sulphate	W-11-7*	*	*	*	*	NS	7-AP	4	*	NS-3*	*	*	*	*	---	---	39156417	0680
	A-11-7*	*	*	*	*	*	7-AP	4	*	NS-3*	*	*	*	*	---	---		0680
4,4'-diaminodiphenyl ether	W-11-6*	1	1	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	---	---	00101804	0680
	A-11-6*	1	1	*	*	*	7-AP	*	*	03-2*	3	*	*	*	---	---		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP X

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H ₂ MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
2,4-diaminotoluene	W-11-6*	2	2	*	*	NS	7-AP	*	*	02-2	2	*	*	*	*--	*--	00095807	0680
	A-11-6*	2	2	*	*	*	7-AP	*	*	02-2	2	*	*	*	*--	*--		0680
4-dimethylaminoazobenzene	W-09-7*	2	2	*	*	NS	7-PH	*	*	NS-3*	*	*	*	*	*--	*--	00060117	0579
	A-09-7*	2	2	*	*	*	7-PH	*	*	NS-3*	*	*	*	*	*--	*--		0579
benzidine and salts	W-10-7*	3	2	*	3	NS	7-HP	*	*	NS-3*	*	*	*	*	*--	*--	00092875G	0579
	A-10-7*	3	2	*	3	*	7-HP	*	*	NS-3*	*	*	*	*	*--	*--		0579
diphenylamine	W-03-6*	1	1	*	*	NS	*--	*	*	02-1*	2	*	*	0	*--	*--	00122394	1079
	A-03-6*	1	1	*	*	*	*--	*	*	02-1*	2	*	*	0	*--	*--		1079
hydrazobenzene	W-09-7*	2	2	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00122667	0579
	A-09-7*	2	2	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP X

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H ₂ MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
4,4'-methylenedibis(2-methyl-	W-11-6*	1	1	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00838880	0680
aniline)	A-11-6*	1	1	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0680
4,4'-methylenedibis(N,N-	W-08-7*	1	1	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00101611	0680
dimethylaniline	A-08-7*	1	1	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
1,5-naphthalenediamine	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	02243621	0680
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
1-naphthylamine	W-10-7*	3	1	*	3	NS	7-PH	*	*	NS-3*	*	*	*	*	*--	*--	00134327	0579
	A-10-7*	3	1	*	3	*	7-PH	*	*	NS-3*	*	*	*	*	*--	*--		0579
2-naphthylamine	W-10-7*	3	1	*	3	NS	7-HP	*	*	NS-3*	*	*	*	*	*--	*--	00091598	0579
	A-10-7*	3	1	*	3	*	7-HP	*	*	NS-3*	*	*	*	*	*--	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP X

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H ₂ MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
p-nitrosodiphenylamine	W-10-5*	3	1	*	3	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	0-B	00156105	0680
	A-10-5*	3	1	*	3	*	7-AP	*	*	NS-3*	*	*	*	*	*--	0-B		0680
phenylenediamines																		G
4-chloro-m-phenylene-	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	05131602	0680
diamine	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
4-chloro-o-phenylene-	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00095830	0680
diamine	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
4,4'-thiodianiline	W-11-6*	1	1	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00139651	0780
	A-11-6*	1	1	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0780

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XI

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
HALOGENATED ALKANES																		
AND ALKENES																		
allyl chloride	W-07-6*	2	*	*	2	NS	3-PA	*	*	02-2*	2	*	*	*	*--	*--	00107051	0679
	A-07-6*	2	*	*	2	*	3-PA	*	*	02-2*	2	*	*	*	*--	*--		0679
benzyl chloride	A-11-5*	7	1	*	*	7	2-SS	*	*	02-1*	2	*	*	0	*--	*--	00100447	1079
	W-06-5*	3	1	*	*	NS	2-SS	*	*	01-1*	1	*	*	0	*--	*--		1079
bromodichloromethane																	00075274	
bromoform																	00075252	
carbon tetrachloride	W-12-4*	2	1	*	2	NS	7-PH	*	*	03-1*	3	*	*	0	*--	0-B	00056235	0579
	A-15-3*	2	1	*	2	*	7-PH	*	3	03-1*	3	*	*	0	*--	0-B		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XI

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
chlorodibromomethane																	00124481	
chlorofluorocarbons																	G	
chlorinated paraffins																	G	
chloroprene	W-13-5*	2	2	*	2	NS	1-SC	*	7	03-2*	3	*	*	*	*--	*--	00126998	0579
	A-13-5*	2	2	*	2	*	1-SC	*	7	03-2*	3	*	*	*	*--	*--		0579
chloroform	W-11-5*	2	1	*	2	NS	7-AP	*	*	02-2*	2	*	*	*	*--	0-B	00067663	0579
	A-15-4*	2	1	*	2	1	7-AP	*	3	03-2*	3	*	*	*	*--	0-B		0579
1,2-dichloroethane	W-10-6*	1	1	*	1	NS	7-AP	*	*	02-2*	2	*	*	*	*--	*--	00107062	0679
	A-10-6*	1	1	*	1	*	7-AP	*	*	02-2*	2	*	*	*	*--	*--		0679

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XI

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
1,1-dichloroethane	A-07-5*	1	1	*	1	0	*---	*	3	03-2*	3	*	*	*	*--	*--	00075343	0780
	W-04-6*	1	1	*	1	NS	*---	*	*	03-2*	3	*	*	*	*--	*--	00075343	0780
1,2-dichloroethylene																	00540590	
1,2-dichloropropane																	00078875	
ethylene dibromide	W-11-6*	2	2	2	2	NS	7-AP	*	*	02-2*	2	*	*	*	*--	*--	00106934	0579
	A-12-6*	2	2	2	2	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0579
fluoroalkenes																	G	
hexachlorobutadiene	W-12-5*	7	2	*	7	NS	3-PA	*	*	02-1*	2	*	*	0	*--	*--	00087683	0579
	A-12-5*	7	2	*	7	*	3-PA	*	*	02-1*	2	*	*	0	*--	*--		0579
hexachlorocyclohexane	W-20-5*	7	2	*	7	NS	7-AP	*	*	*	4-S	*	*	*	4-S	*--	00608731	0579
	A-20-5*	7	2	*	7	*	7-AP	*	*	*	4-S	*	*	*	4-S	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XI

	TOTAL	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS	DATE
	SCORES	TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE			NUMBER	
hexachloroethane	W-07-6*	1	1	*	*	NS	3-PA	*	*	03-2*	3	*	*	*	*--	*--	00067721	0579
	A-07-6*	1	1	*	*	*	3-PA	*	*	03-2*	3	*	*	*	*--	*--		0579
methyl chloride																	00074873	
methylene chloride																	00075092	
1,1,2,2-tetrachloroethane	A-08-4*	2	2	0	2	*	3-PA	*	*	03-1*	3	0	*	0	*--	0-B	00079345	1080
	W-07-4*	2	2	0	2	NS	3-PA	*	*	02-1*	2	0	*	0	*--	0-B		1080
tetrachloroethylene /	W-11-5*	2	*	*	2	NS	7-AP	*	*	02-2*	2	*	*	*	*--	0-B	00127184	0680
perchloroethylene	A-11-5*	2	*	*	2	*	7-AP	*	*	02-2*	2	*	*	*	*--	0-B		0680
1,1,1-trichloroethane																	00071556	

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XI

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
1,1,2-trichloroethane	W-08-6*	2	1	*	2	NS	3-PA	*	*	03-2*	3	*	*	*	*--	*--	00079005	0579
	A-08-6*	2	1	*	2	*	3-PA	*	*	03-2*	3	*	*	*	*--	*--		0579
trichloroethylene	W-07-5*	2	1	*	2	NS	3-PA	*	*	02-2*	*	2	*	*	*--	0-B	00079016	0579
	A-07-5*	2	1	*	2	1	3-PA	*	*	02-2*	*	2	*	*	*--	0-B		0579
vinyl chloride	A-11-6*	2	2	*	0	*	7-PH	*	*	02-2*	2	*	*	*	*--	*--	00075014	0579
	W-06-6*	2	2	*	0	NS	2-SS	*	*	02-2*	2	*	*	*	*--	*--		0579
vinylidene chloride	A-11-5*	2	2	*	2	2	7-AP	*	*	02-2*	2	*	*	*	*--	0-P	00075354	0780
	W-06-5*	2	2	*	2	NS	2-SS	*	*	02-2*	2	*	*	*	*--	0-P		0780

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
ALKYL EPOXIDES																		
alkyl epoxides																	G	
glycidol and its derivatives																	00556525G	
1-chloro-2,3-epoxypropane	W-07-6*	2	2	1	2	NS	*---	*	*	03-2*	3	*	*	*	0-W	*--	00106898	0579
	A-07-5*	2	2	1	2	1	2-SS	*	*	03-2*	3	*	*	*	0-W	*--		0579
1,2: 3,4-diepoxybutane	W-09-7*	2	2	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00298180	0579
	A-14-7*	7	2	*	*	7	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0579
ethylene oxide	W-10-2*	2	2	*	2	NS	2-SS	7	*	02-1*	2	*	*	0	0-W	0-P	00075218	0780
	A-14-2*	3	2	*	2	3	2-SS	7	*	02-1*	2	*	*	0	0-W	0-P		0780

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XIII

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XIV

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
CHLOROALCOHOLS AND ETHERS																		
2-chloroethanol	W-03-8*	3	2	3	1	NS	*---	*	*	NS-3*	*	*	*	*	*--	*--	00107073	0679
	A-07-8*	7	2	3	1	7	*---	*	*	NS-3*	*	*	*	*	*--	*--		0679
bis(2-chloroethyl)ether	W-08-6*	2	2	2	1	NS	3-PA	*	*	03-2*	3	*	*	*	*--	*--	00111444	0679
	A-08-6*	2	2	2	1	*	3-PA	*	*	03-2*	3	*	*	*	*--	*--		0679
bis(chloromethyl)ether	W-10-4*	2	2	2	*	NS	7-HP	*	*	01-2*	1	*	*	*	0-R	0-P	00542881	0579
	A-11-4*	2	2	2	*	*	7-HP	*	*	02-2*	2	*	*	*	0-R	0-P		0579
bis(2-chloro-isopropyl)ether																	00108601	
																		0579
methyl(chloromethyl)ether	A-11-4*	1	1	*	1	*	7-PH	*	*	03-2*	3	*	*	*	0-W	0-P	00107302	0579
	W-03-5*	1	1	*	1	NS	2-SS	*	*	NS-3*	*	*	*	*	0-W	0-P		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XV

	TOTAL SCORES	ACUTE TOXICITY					CARCIN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
POLYCHLORINATED COMPOUNDS																		
N.O.S.																		
hexachlorocyclopentadiene	W-11-5*	7	2	1	7	NS	*---	*	*	02-1*	2	*	*	1	*--	1-B	00077474	0579
	A-11-5*	7	2	1	7	7	*---	*	*	02-1*	2	*	*	1	*--	1-B		0579
mirex	W-19-5*	2	2	1	*	NS	7-AP	*	3	07-2*	*	7	*	*	*--	*--	02385855	0579
	A-19-5*	2	2	1	*	*	7-AP	*	3	07-2*	*	7	*	*	*--	*--		0579
polychlorinated terphenyls																	G	

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XVI

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XVII

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XVIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
NITROGEN COMPOUNDS N.O.S.																		
acenaphthene,5-nitro	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00602879	0680
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
acetonitrile																	00075058	
2-acetylaminofluorene	W-08-7*	1	1	*	*	NS	7-HP	*	*	NS-3*	*	*	*	*	*--	*--	00053963	0679
	A-08-7*	1	1	*	*	*	7-HP	*	*	NS-3*	*	*	*	*	*--	*--		0679
acrylonitrile	W-16-5*	3	3	*	2	NS	7-AP	*	3	03-2*	3	*	*	*	*--	*--	00107131	0679
	A-16-5*	3	3	*	2	*	7-AP	*	3	03-2*	3	*	*	*	*--	*--		0679
alkyl amines																	G	

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XVIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
NITROGEN COMPOUNDS N.O.S.																		
azo dyes																	G	
benz(a)acridine																	00225116	
benz(c)acridine																	00225114	
chloro-anilines																	G	
cycloheximide	W-097*	7	7	*	*	NS	*---	*	*	02-2*	*	2	*	*	*--	*--	00066819	0679
	A-09-7*	7	7	*	*	*	*---	*	*	02-2*	*	2	*	*	*--	*--		0679
3,3'-dichlorobenzidine	W-07-7*	*	*	*	*	NS	7-PH	*	*	NS-3*	*	*	*	*	*--	0-P	00091941G	0579
and salts	A-07-7*	*	*	*	*	*	7-PH	*	*	NS-3*	*	*	*	*	*--	0-P		0579
dimethylhydrazines	W-15-5*	3	3	*	*	NS	7-AP	*	3	02-2*	2	*	*	*	*--	*--	G	0579
	A-15-5*	3	3	*	*	*	7-AP	*	3	02-2*	2	*	*	*	*--	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XVIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
NITROGEN COMPOUNDS N.O.S.																		
ethyleneimine	W-17-4*	7	7	3	*	NS	7-PH	*	*	03-2*	3	7	*	*	0-W	0-P	00151564	0579
	A-21-4*	7	7	3	*	7	7-PH	*	*	07-2*	7	7	*	*	0-W	0-P		0579
hexamethylphosphoramide	W-06-6*	1	1	1	0	NS	2-SS	*	*	03-2*	3	*	*	*	*--	*--	00680319	0680
	A-11-6*	1	1	1	0	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0680
hydrazine	W-11-5*	3	2	7	*	NS	7-AP	*	*	01-1*	1	*	*	0	*--	*--	00302012	0579
	A-17-5*	7	2	7	*	7	7-AP	*	*	03-1*	3	*	*	0	*--	*--		0579
methylenebis(2-chloroaniline)	W-08-7*	1	1	*	*	NS	7-PH	*	*	NS-3*	*	*	*	*	*--	*--	00101144	0579
	A-08-7*	1	1	*	*	*	7-PH	*	*	NS-3*	*	*	*	*	*--	*--		0579
methyl hydrazine	W-07-6*	3	3	3	*	NS	3-PA	*	*	01-2*	1	*	*	*	*--	*--	00060344	0579
	A-15-5*	7	3	3	*	7	3-PA	*	3	02-2*	2	*	*	*	*--	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XVIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
NITROGEN COMPOUNDS N.O.S.																		
nitro-aromatics																	G	
4-nitrophenyl	W-08-7*	1	1	*	*	NS	7-PH	*	*	NS-3*	*	*	*	*	*--	*--	00092933	0579
	A-08-7*	1	1	*	*	*	7-PH	*	*	NS-3*	*	*	*	*	*--	*--		0579
nitro-anilines																	G	0579
2-methyl-1-nitroanthraquin-	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00129157	0680
one	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
propane, 2-nitro	A-07-5*	2	*	*	2	*	3-PA	*	*	02-1*	2	*	*	0	*--	*--	00079469	0680
	W-05-5*	2	*	*	2	NS	2-SS	*	*	01-1*	1	*	*	0	*--	*--		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XVIII

	TOTAL	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS	DATE
	SCORES	TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE			NUMBER	
NITROGEN COMPOUNDS N.O.S.																		
propyleneimine	W-13-6*	3	3	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00075558	0579
	A-13-6*	3	3	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0579
quinoline																	00091225	
semicarbazide	W-12-6*	2	2	*	*	NS	3-PA	*	7	NS-3*	*	*	*	*	*--	*--	00057567	0579
	A-12-6*	2	2	*	*	*	3-PA	*	7	NS-3*	*	*	*	*	*--	*--		0579
tetranitromethane	A-09-7*	7	2	*	*	7	*--	*	*	02-2*	2	*	*	*	*--	*--	00509148	0780
	W-02-8*	2	2	*	*	NS	*--	*	*	NS-3*	*	*	*	*	*--	*--		0780

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XIX

	TOTAL	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS	DATE
	SCORES	TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE			NUMBER	
NITROSAMINES																		
nitrosamines																	G	
N-nitroso-n-butyl-N-	W-11-6*	1	1	*	*	NS	7-HP	*	*	03-2*	3	*	*	*	*--	*--	03817116	0680
(4-hydroxybutyl)-amine	A-11-6*	1	1	*	*	*	7-HP	*	*	03-2*	3	*	*	*	*--	*--		0680
N-nitrosodiethylamine	W-12-6*	2	2	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00055185	0579
	A-12-6*	2	2	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0579
N-nitroso-N-methylurea	W-14-4*	2	2	*	*	NS	7-AP	4	*	01-2*	1	*	*	*	0-W	*--	00684935	0680
	A-14-4*	2	2	*	*	*	7-AP	4	*	01-2*	1	*	*	*	0-W	*--		0680
N-nitroso-di-n-butylamine	W-11-6*	1	1	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00924163	0780
	A-11-6*	1	1	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0780
N-nitrosodimethylamine	W-13-6*	3	3	*	*	NS	7-PH	*	*	03-2*	3	*	*	*	*--	*--	00062759	0780
	A-17-6*	7	3	*	*	7	7-PH	*	*	03-2*	3	*	*	*	*--	*--		0780

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XIX

	TOTAL	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS	DATE
	SCORES	TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE			NUMBER	
NITROSAMINES																		
N-nitroso-N-ethylurea	W-15-4*	2	2	*	*	NS	7-PH	4	*	02-2*	2	*	*	*	0-W	*--	00759739	0680
	A-15-4*	2	2	*	*	*	7-PH	4	*	02-2*	2	*	*	*	0-W	*--		0680
N-nitrosomethylvinylamine	W-06-7*	3	3	*	*	NS	3-PA	*	*	NS-3*	*	*	*	*	*--	*--	04549400	0680
	A-10-7*	3	3	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680
N-nitroso-N-methylurethane	W-17-4*	2	2	*	*	NS	7-AP	7	*	01-2*	1	*	*	*	0-W	*--	00615532	0780
	A-17-4*	2	2	*	*	*	7-AP	7	*	01-2*	1	*	*	*	0-W	*--		0780
N-nitrosomorpholine	W-11-6*	2	2	*	*	NS	7-AP	*	*	02-2*	2	*	*	*	*--	*--	00059892	0680
	A-11-6*	2	2	*	*	*	7-AP	*	*	02-2*	2	*	*	*	*--	*--		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XIX

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
NITROSAMINES																		
N-nitroso-N-phenyl-																	00135206	
hydroxylamine,	W-09-7*	*	*	*	*	NS	7-AP	*	*	02-2*	2	*	*	*	*--	*--		0680
ammonium salt	A-09-7*	*	*	*	*	*	7-AP	*	*	02-2*	2	*	*	*	*--	*--		0680
N-nitrososarcosine	W-08-7*	1	1	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	13256229	0680
	A-08-7*	1	1	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XX

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
COMPOUNDS NOT OTHERWISE																		
SPECIFIED																		
aryl sulfonic acids																	G	
benzothiazole																	00095169	
carbon disulphide	W-04-6*	1	*	*	1	NS	*---	*	*	03-1*	3	*	*	0	*--	*--	00075150	0579
	A-04-6*	1	*	*	1	*	*---	*	*	03-1*	3	*	*	0	*--	*--		0579
cyclohexane																	00110827	
cyclohexanone																	00108941	
dimethylsulphate	W-04-6*	2	*	*	2	NS	2-SS	*	*	NS-3*	*	*	*	*	*--	*--	00077781	0780
	A-13-6*	7	*	*	2	7	3-PA	*	*	03-2*	3	*	*	*	*--	*--		0780

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XX

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H ₂ MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
COMPOUNDS NOT OTHERWISE SPECIFIED																		
1,4-dioxane	W-10-6*	1	1	0	1	NS	7-AP	*	*	02-2*	2	*	*	*	*--	*--	00123911	0680
	A-11-6*	2	1	0	1	2	7-AP	*	*	02-2*	2	*	*	*	*--	*--		0680
ethylene thiourea	W-16-6*	*	*	*	*	NS	7-AP	*	7	02-2*	2	*	*	*	*--	*--	00096457	0579
	A-16-6*	*	*	*	*	*	7-AP	*	7	02-2*	2	*	*	*	*--	*--		0579
ethyl methanesulfonate	W-10-6*	*	*	*	*	NS	2-SS	7	*	01-2*	1	*	*	*	*--	*--	00062500	0680
	A-10-6*	*	*	*	*	*	2-SS	7	*	01-2*	1	*	*	*	*--	*--		0680
fatty acids																	G	
2-(2-formylhydrazine)-4-(5- nitro-2-furyl)thiazole	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	03570750	0680
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0680

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XX

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
COMPOUNDS NOT OTHERWISE SPECIFIED																		
mercaptans																G		
methyl mercaptan	W-09-5*	7	*	*	7	NS	*---	*	*	02-2*	1	*	*	1	0-S	*--	00074931	0579
	A-10-5*	7	*	*	7	*	*--	*	*	03-1*	2	*	*	1	0-S	*--		0579
1,2-(methylenedioxy)-4- propenyl-benzene	W-11-6*	1	1	*	*	NS	7-AP	*	*	03-2*	3	*	*	*	*--	*--	00120581	0579
	A-11-6*	1	1	*	*	*	7-AP	*	*	03-2*	3	*	*	*	*--	*--		0579
phosgene	W-00-8*	*	*	*	*	NS	*---	*	*	00-2*	*	*	*	0	*--	*--	00075445	0780
	A-07-7*	7	*	*	*	7	*---	*	*	00-2*	*	*	*	0	*--	*--		0780
1,3-propane sulfone	W-07-8*	*	*	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	01120714	0679
	A-07-8*	*	*	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0679

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XX

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H. MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
COMPOUNDS NOT OTHERWISE SPECIFIED																		
beta-propiolactone	W-10-5*	3	3	*	1	NS	7-PH	*	*	NS-3*	*	*	*	*	0-N	0-P	00057578	0579
	A-10-5*	3	3	*	1	*	7-PH	*	*	NS-3*	*	*	*	*	0-N	0-P		0579
5-propyl-1,3-benzodioxole	W-10-6*	1	1	0	*	NS	7-AP	*	*	02-2*	2	*	*	*	*--	*--	00094586	0680
	A-10-6*	1	1	0	*	*	7-AP	*	*	02-2*	2	*	*	*	*--	*--		0680
thiourea	W-09-7*	2	2	*	*	NS	7-AP	*	*	NS-3*	*	*	*	*	*--	*--	00062566	0679
	A-09-7*	2	2	*	*	*	7-AP	*	*	NS-3*	*	*	*	*	*--	*--		0679

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XXI

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XXI I

[illegible]

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XXIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
INORGANICS, METALS, FIBRES																		
aluminum & selected compounds																	07429905G	
antimony & selected compounds	W-15-4*	3	2	*	3	NS	*---	*	*	05-1*	3	*	2	*	N-A	7-B	07440360G	0579
	A-15-4*	3	2	*	3	*	*---	*	*	05-1*	3	*	2	*	N-A	7-B		0579
arsenic & selected compounds	W-20-2*	3	3	*	3	NS	7-HP	*	3	05-1*	3	2	2	*	N-A	2-B	07440382G	0579
	A-20-2*	3	3	*	3	*	7-HP	*	3	05-1*	3	2	2	*	N-A	2-B		0579
asbestos & related asbestos	A-10-6*	*	*	*	*	*	7-AP	*	*	03-2*	3	*	*	*	N-A	*--	01332214G	0579
fibres	W-03-6*	*	*	*	*	NS	2-SS	*	*	01-2*	1	*	*	*	N-A	*--		0579
beryllium & selected cmpds	W-12-5*	7	2	*	7	NS	2-SS	*	*	03-2*	3	*	*	*	N-A	*--	07440417G	0780
	A-17-5*	7	2	*	7	*	7-AP	*	*	03-2*	3	*	*	*	N-A	*--		0780

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XXIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
cadmium & selected compounds	W-19-4*	7	2	*	7	NS	2-SS	*	*	07-2*	*	7	*	*	N-A	3-B	07440439G	0579
	A-24-4*	7	2	*	7	7	7-HP	*	*	07-2*	*	7	*	*	N-A	3-B		0579
chromium & selected compounds	W-07-3*	3	2	*	3	NS	2-SS	*	*	02-0*	1	2	2	0	N-A	*--	07440473G	0680
	A-15-3*	3	2	*	3	*	7-HP	*	*	05-0*	3	2	2	0	N-A	*--		0680
cobalt & selected compounds	W-07-5*	2	2	*	*	NS	*---	*	*	03-2*	3	*	*	*	N-A	2-B	07440484G	0579
	A-07-5*	2	2	*	*	*	*---	*	*	03-2*	3	*	*	*	N-A	2-B		0579
copper & selected compounds	W-13-4*	7	3	*	7	NS	*---	*	*	06-0*	3	*	3	0	N-A	*--	07440508G	0579
	A-13-4*	7	3	*	7	*	*---	*	*	06-0*	3	*	3	0	N-A	*--		0579
cyanides	W-10-5*	7	7	*	7	NS	*---	*	*	03-2*	2	3	*	*	N-A	0-B	G	0579
	A-10-5*	7	7	*	7	*	*---	*	*	03-2*	2	3	*	*	N-A	0-B		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XXIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
fluorides																	G	
lead & selected compounds	W-24-4*	7	2	*	7	NS	7-AP	*	3	07-2*	7	*	*	*	N-A	*--	07439921G	0579
	A-24-4*	7	2	*	7	*	7-AP	*	3	07-2*	7	*	*	*	N-A	*--		0579
mercury & selected compounds	W-24-4*	7	2	*	7	NS	*--	*	7	03-2*	3	*	*	*	N-A	7-B	07439976G	0579
	A-24-4*	7	2	*	7	*	*--	*	7	03-2*	3	*	*	*	N-A	7-B		0579
nickel & selected compounds	W-19-4*	3	3	*	3	NS	2-SS	*	*	07-2*	3	7	*	*	N-A	7-B	07440020G	0579
	A-24-4*	3	3	*	3	*	7-PH	*	*	07-2*	0	7	*	*	N-A	7-B		0579
selenium & selected compounds	W-19-4*	2	2	*	2	NS	7-AP	*	7	03-2*	3	*	*	*	N-A	*--	07782492G	0579
	A-24-4*	7	2	*	2	7	7-AP	*	7	03-2*	3	*	*	*	N-A	*--		0579
silver & selected compounds	W-10-6*	7	3	*	7	NS	*--	*	*	03-2*	3	*	*	*	N-A	*--	07440224G	0579
	A-10-6*	7	3	*	7	*	*--	*	*	03-2*	3	*	*	*	N-A	*--		0579

PRELIMINARY ENVIRONMENTAL AND HUMAN HEALTH EFFECTS ASSESSMENT: GROUP XXIII

	TOTAL SCORES	ACUTE TOXICITY					CARCN	H.MUT	TERT	OTHER ADVERSE EFFECTS					PERS	BIOA	CAS NUMBER	DATE
		TOT	ORA	DER	AQU	INH				TOTAL	ATE	AQU	APE	AAE				
strontium & selected cmpds																	07440246G	
thallium & selected compounds																	07440280G	
vanadium & selected cmpds																	07440622G	
zinc & selected compounds	W-10-4*	7	2	*	7	NS	*---	*	*	03-1*	2	3	*	0	N-A	0-B	07440666G	0579
	A-10-4*	7	2	*	7	*	*---	*	*	03-1*	2	3	*	0	N-A	0-B		0579

TABLE 4

**CHEMICALS FOR FURTHER EVALUATION THAT HAVE BEEN ASSESSED IN THE
1981 CRITICAL MATERIALS REGISTER (CMR), OR IN THE 1981 AIR
PRIORITY CHEMICALS LIST (APCL) ***

TOTAL SCORES IN DESCENDING ORDER

SUBSTANCE NAME	CMR	APCL
PCDD'S	W-33-3*	A-33-3*
PCB'S	W-31-3*	A-31-3*
hexachlorobenzene	W-29-2*	A-29-2*
cadmium & selected compounds	W-19-3*	A-24-4*
lead & selected compounds	W-24-4*	A-24-4*
mercury & selected compounds	W-24-4*	A-24-4*
pentachlorophenol	W-24-4*	A-24-4*
nickel & selected compounds	W-19-4*	A-24-4*
selenium & selected compounds	W-19-4*	A-24-4*
ethyleneimine	W-17-4*	A-21-4*
arsenic & selected compounds	W-20-2*	A-20-2*
hexachlorocyclohexane	W-20-5*	A-20-5*
mirex	W-19-5*	A-19-5*
beryllium & selected compounds	W-12-5*	A-17-5*
hydrazine	W-11-5*	A-17-5*
N-nitrosodimethylamine	W-13-6*	A-17-6*
N-nitroso-N-methylurethane	W-17-4*	A-17-4*
polybrominated biphenyls	W-17-4*	A-17-4*
acrylonitrile	W-16-5*	A-16-5*
ethylene thiourea	W-16-6*	A-16-6*
antimony & selected compounds	W-15-4*	A-15-4*
N-nitroso-N-ethylurea	W-15-4*	A-15-4*

* - this table provides a summary of both the available information and the information gaps for the Chemicals for Further Evaluation that have been assessed. This table is not intended to be a priority ranking of these chemicals.

SUBSTANCE NAME	CMR	APCL
carbon tetrachloride	W-12-4*	A-15-3*
chloroform	W-11-5*	A-15-4*
dimethylhydrazines	W-15-5*	A-15-5*
methyl hydrazine	W-07-6*	A-15-5*
chromium & selected compounds	W-07-3*	A-15-3*
1,2:3,4-diepoxybutane	W-09-7*	A-14-7*
ethylene oxide	W-10-2*	A-14-2*
N-nitroso-N-methylurea	W-14-4*	A-14-4*
chloroprene	W-13-5*	A-13-5*
copper & selected compounds	W-13-4*	A-13-4*
dimethyl sulphate	W-04-6*	A-13-6*
propyleneimine	W-13-6*	A-13-6*
ethylene dibromide	W-11-6*	A-12-6*
hexachlorobutadiene	W-12-5*	A-12-5*
N-nitrosodiethylamine	W-12-6*	A-12-6*
semicarbazide	W-12-6*	A-12-6*
trichlorophenols	W-12-5*	A-12-5*
aminotriazole	W-11-5*	A-11-5*
benzene	W-11-6*	A-11-6*
benzyl chloride	W-06-5*	A-11-5*
bis(chloromethyl)ether	W-10-4*	A-11-4*
4,4'-diaminodiphenyl ether	W-11-6*	A-11-6*
2,4-diaminoanisole sulphate	W-11-7*	A-11-7*
2,4-diaminotoluene	W-11-6*	A-11-6*
1,4-dioxane	W-10-6*	A-11-6*
hexachlorocyclopentadiene	W-11-5*	A-11-5*
hexamethylphosphoramide	W-06-6*	A-11-6*
methyl(chloromethyl)ether	W-03-5*	A-11-4*

SUBSTANCE NAME	CMR	APCL
4,4'-methylenebis (2-methylaniline)	W-11-6*	A-11-6*
1,2-(methylenedioxy)-4- propenyl-benzene	W-11-6*	A-11-6*
N-nitroso-di-n-butylamine	W-11-6*	A-11-6*
N-nitrosomorpholine	W-11-6*	A-11-6*
N-nitroso-n-butyl-N- (4-hydroxybutyl)amine	W-11-6*	A-11-6*
tetrachloroethylene	W-11-5*	A-11-5*
4',4-thiodianiline	W-11-6*	A-11-6*
vinyl chloride	W-06-6*	A-11-6*
vinylidene chloride	W-06-5*	A-11-5*
2-aminoanthraquinone	W-10-7*	A-10-7*
o-aminoazotoluene	W-10-7*	A-10-7*
1-amino-2-methyl -anthraquinone	W-10-7*	A-10-7*
asbestos & related asbestos fibres	W-03-6*	A-10-6*
benzidine & salts	W-10-7*	A-10-7*
cyanides	W-10-5*	A-10-5*
1,2-dichloroethane	W-10-6*	A-10-6*
ethyl methanesulphonate	W-10-6*	A-10-6*
formaldehyde	W-05-6*	A-10-6*
methyl mercaptan	W-09-5*	A-10-5*
1-naphthylamine	W-10-7*	A-10-7*
2-naphthylamine	W-10-7*	A-10-7*
p-nitrosodiphenylamine	W-10-5*	A-10-5*
N-nitrosomethylvinylamine	W-06-7*	A-10-7*
beta-propiolactone	W-10-5*	A-10-5*
5-propyl-1,3-benzodioxole	W-10-6*	A-10-6*

SUBSTANCE NAME	CMR	APCL
silver & selected compounds	W-10-6*	A-10-6*
o-toluidine hydrochloride	W-10-6*	A-10-6*
triaryl phosphate esters	W-10-7*	A-10-7*
zinc & selected compounds	W-10-4*	A-10-4*
4-aminobiphenyl	W-09-7*	A-09-7*
3-amino-9-ethylcarbazole	W-09-7*	A-09-7*
3-(chloromethyl)pyridine hydrochloride	W-09-7*	A-09-7*
cycloheximide	W-09-7*	A-09-7*
4-dimethylaminoazobenzene	W-09-7*	A-09-7*
di-n-butyl phthalate	W-09-7*	A-09-7*
di-n-octyl phthalate	W-09-7*	A-09-7*
bis-2(ethylhexyl)phthalate	W-09-5*	A-09-5*
hydrazobenzene	W-09-7*	A-09-7*
N-nitroso-N-phenylhydroxylamine -ammonium salt	W-09-7*	A-09-7*
tetranitromethane	W-02-8*	A-09-7*
thiourea	W-09-7*	A-09-7*
2-acetylaminofluorene	W-08-7*	A-08-7*
o-anisidine	W-08-7*	A-08-7*
bis(2-chloroethyl)ether	W-08-6*	A-08-6*
p-cresidine	W-08-7*	A-08-7*
methylenebis(2-chloroaniline)	W-08-7*	A-08-7*
4,4'-methylenebis- (N,N-dimethylaniline)	W-08-7*	A-08-7*
5-nitro-o-anisidine	W-08-7*	A-08-7*
4-nitrobiphenyl	W-08-7*	A-08-7*
N-nitrososarcosine	W-08-7*	A-08-7*
1,1,2,2-tetrachloroethane	W-07-4*	A-08-4*
1,1,2-trichloroethane	W-08-6*	A-08-6*

SUBSTANCE NAME	CMR	APCL
2,4,5-trimethylaniline	W-08-7*	A-08-7*
acenaphthene,5-nitro	W-07-8*	A-07-8*
allyl chloride	W-07-6*	A-07-6*
aminoazobenzene	W-07-8*	A-07-8*
aniline	W-07-5*	A-07-5*
o-anisidine hydrochloride	W-07-8*	A-07-8*
benz(a)anthracene	W-07-8*	A-07-8*
benzo(a)pyrene	W-07-8*	A-07-8*
1-chloro-2,3-epoxypropane	W-07-6*	A-07-5*
2-chloroethanol	W-03-8*	A-07-8*
4-chloro-m-phenylene- diamine	W-07-8*	A-07-8*
4-chloro-o-phenylene- diamine	W-07-8	A-07-8*
cobalt & selected compounds	W-07-5*	A-07-5*
dibenz(a,h)anthracene	W-07-8*	A-07-8*
3,3'-dichlorobenzidine and salts	W-07-7*	A-07-7*
1,1-dichloroethane	W-04-6*	A-07-5*
2-(2-formylhydrazine)-4- (5-nitro-2-furyl)thiazole	W-07-8*	A-07-8*
hexachloroethane	W-07-6*	A-07-6*
2-methyl-1-nitroanthraquinone	W-07-8*	A-07-8*
1,5-naphthalenediamine	W-07-8*	A-07-8*
2-nitropropane	W-05-5*	A-07-5*
phosgene	W-00-8*	A-07-7*
polychlorinated dibenzofurans	W-07-8*	A-07-8*
1,3-propane sultone	W-07-8*	A-07-8*
styrene	W-07-5*	A-07-5*
o-toluidine	W-07-5*	A-07-5*
trichloroethylene	W-07-5*	A-07-5*

SUBSTANCE NAME	CMR	APCL
xylene	W-07-4*	A-07-4*
biphenyl	W-06-6*	A-06-6*
cresols	W-06-6*	A-06-6*
naphthalene	W-06-6*	A-06-6*
phenols	W-05-5*	A-06-6*
furfural	W-03-6*	A-05-6*
carbon disulphide	W-04-6*	A-04-6*
benzo(b)fluoranthene	W-03-8*	A-03-8*
diphenylamine	W-03-6*	A-03-6*
dibenzo(a,i)pyrene	W-02-8*	A-02-8*
dibenzo(b,def)chrysene	W-02-8*	A-02-8*
indeno(1,2,3-cd)pyrene	W-02-8*	A-02-8*

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